THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

VOL. XVI. No. 385—19th YEAR.] LONDON, JULY 23, 1867. [Subscription per Ann. { 15s. in Advance / 18s. Credit.] TREBLE No. 1s. 4d. Unstamped.

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1862.

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I.—"On Substitutes for Cannel Coal to be used in the Manufacture of Illuminating Gas," by Mr. G. R. Hislop, Gas-Works, Paisley.
II.—"On Utilizing the Gas produced in the Manufacture of Paraffin Oil," by Mr. John Young, Gas-Works, Hawick.
III.—Lecture on "The Chemistry of Gas Lighting," with Illustrations, by Dr. Stevenson Macadam, F.R.S.E., Lecturer on Chemistry, Edinburgh.
At Three o'clock p.m. the members and friends will dine together in the Ship Hotel, East Register Street, Edinburgh.
W. MACKENZIE, Secretary.
Gas-Works, Dunfirmline, July 16, 1867.

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4. The gas passing without being registered at all.
5. The temptations and facilities to fraud which it is notorious the Wet Meter presents.

1862.

CLASSES X. & XXXI.

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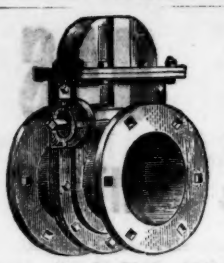

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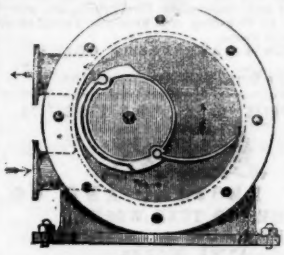

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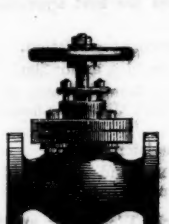

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TO CORRESPONDENTS.

F. M.—*The special meters for public lamps mentioned by Mr. Hawksley in his address at Nottingham are made by Mr. Sugg, Vincent Works, Vincent Street, Regent Street, Westminster.*

THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 23, 1867.

Notes upon Passing Events.

THE water supply of London has for some years attracted increased attention. With the advance of social civilization there is a more generally diffused demand for social comforts, one of the first of which is an ample supply of pure water. While medical investigation has made us almost as critical about our water as our wine, the advances of population and the general use of one of the mechanical aids of domestic luxury, have befouled numerous once pellucid streams. To the discussions that have arisen there are, of course, three parties:—The vested interests and stolidly indifferent, who believe that "everything is for the best in the best possible of "worlds," and denying the necessity of any change; the mad doctors and their pupils, who would drive us back to rain water, filtered under *their* auspices, whose sanitary regulations would make us all worse off than Sancho Panza during his brief government of Barataria; and the reasonable men, who know that reasonable precautions and a reasonable expenditure will give the inhabitants of the metropolis all that is required for health and cleanliness. The possible effect of impure water on the spread of cholera has had its result in stimulating the demand for inquiry into the whole subject. It was under these circumstances that the East London Thames Supply Water Bill, having been read a second time this session in the House of Commons, was referred to a committee, with instructions to "inquire into the operation and results of the Metro-"polis Water Act, 1852." The report of this committee is, in fact, a summary of the legislation on the subject, and also of the demands likely to be made and enforced on the water companies. The school of philosophers who find everything in the shape of sanitary arrangement wrong, and who wish, like the great pensioned C.B., to introduce an entirely new system of doing everything of an engineering character, entirely forget when treating of the metropolis, that the sanitary appliances of that vast population have grown with its wants, and were therefore, fifteen years ago, open to an amount of criticism which could not be directed on towns provided with spick and span new arrangements, devised with the benefit of at least a century of experience. Within the memory of living men, Nottingham, Birmingham, and Glasgow have been dependent on water-carts and wells for a daily supply of water. London began early to bring water to the door of the majority of its inhabitants. The water companies, whose enterprise provided the comfort and luxury of a house supply, did not go to the nuisances that have deteriorated some of their sources. The nuisances grew round them, while public taste, educated, became, fortunately for public health, more nice. The committee have taken this rational view, as will be seen from the following summary of the principal points of their report:—The several companies, established for the purpose of supplying the inhabitants of London with water, began with competition, and finished, as great companies always must, with a coalition, for equal rates and separate districts. Soon the consumers complained of the monopoly, and in 1821 a committee of the House was appointed to inquire into the whole subject of the water supply of the metropolis. This committee, after pointing out that the inhabitants of London were better supplied with water than those of any other city of Europe, recommended that an Act should be passed prescribing the maximum rates to be charged by the companies, and enforcing arrangements to prevent waste of water. But the time of political apathy preceding a political storm was not favourable to general and comprehensive legislation. In 1828 an alarm arose, with ample foundation, that the water then drawn from the tidal waters of the Thames near London was unwholesome. A Royal Commission was appointed to ascertain the sources and means of supply, the quality of the water, and to find out, if necessary, new sources of supply. The commission reported that as the water of the Thames approached

the metropolis "it became loaded with filth." This report was referred to a committee of the House of Commons, which recommended that Mr. Telford should be employed to prepare a scheme for supplying the whole of the metropolis with wholesome water. Legislation marched slowly in those days. In 1834, Mr. Telford recommended that the southern part of the metropolis, then supplied from the Thames, should be supplied from the river Wandle, and the northern part from the river Colne. This report was referred to a select committee, which, in consequence of the lateness of the session, merely reported the evidence to the House. The question rested for six years, until in 1840 the House appointed a committee and took evidence, without reporting on the metropolitan water supply. In 1849 an outbreak of cholera again called attention to the water of London. The Board of Health, then newly appointed, and under the guidance of Mr. Edwin Chadwick, reported entirely against the existing system of supply, and on the evidence of a young officer of the Royal Engineers, proposed an entirely *new system*, under which the water of London was to be entirely supplied on the one side from reservoirs filled from gathering-grounds in the Bagshot sands, and on the Surrey side from the district known as Hind Head, to the south of Guildford. We may add that if this theory had been carried out the whole supply would have totally ceased in subsequent dry years. In the same year, a Bill having been introduced bearing upon the supply of the river Lea, the report of the Board of Health underwent a severe scrutiny before a committee of the House, and the theories of the water doctor-quacks were completely pulled to pieces. About the deficiency and inferior quality of the existing supply there was no possible dispute, but, as usual in times of plague and pestilence, quacks arose and made themselves heard, and amongst them none were louder or more plausible than the arch-quack of the Board of Health—the lawyer who first drew his brief, and then collected evidence to fit his case. A scientific commission, appointed by the Government, reported, in 1850, that the water supplied to the metropolis had (naturally) no unwholesome qualities; that there was no reason for believing that the mineral qualities of water were injurious to health. They recommended that the supply should be protected from town sewage, and they condemned the proposed plan of the Board of Health. In 1851, Her Majesty's Government introduced a Bill to vest the future supply of the metropolis with water in commissioners, and it is, perhaps, to be regretted that the attempt was not so far successful that the companies had been reduced to not more than three. A committee of the House of Commons investigated this Bill, and came to the conclusion that by proper arrangements the existing defects might be remedied, and a sufficient supply of water of good quality obtained from the valley of the Thames and the other sources employed by the existing companies. Thus the House of Commons was in possession of the most complete information before passing the Act of 1852, which at present regulates the water companies, and which it is now proposed still further to amend.

The following are the chief provisions of the Metropolis Water Act of 1852. The companies were prohibited after August, 1855, from taking water at any part of the river Thames below Teddington Lock, or from any tributary stream or any part below the highest point at which the tide flowed. The reservoirs of all companies within a direct distance of five miles from St. Paul's were to be roofed over, unless the water was to be filtered after leaving the reservoir. All water was to be filtered unless drawn direct from wells into a covered reservoir for distribution. The committee having traced legislation to this point, proceeded to examine the results of the works executed in consequence of the Act of 1852, and to ascertain how far it secured the metropolis a sufficient supply of wholesome water. Since 1852 the five companies drawing their supplies chiefly from the Thames have expended the following sums:—

The Chelsea Company . . .	£525,756
The West Middlesex . . .	292,271
The Grand Junction . . .	391,440
The Southwark and Vauxhall .	661,179
The Lambeth	559,321
Total	£2,429,967

From these works the five companies obtained an average daily supply, in 1856, the first year that the Act came into full operation, as follows:—

	Gallons.
The Chelsea Company . .	5,532,000
The West Middlesex . . .	6,005,293
The Grand Junction . . .	5,478,361
The Southwark and Vauxhall .	10,531,122
The Lambeth	5,391,000
Total	32,937,776

The quantity of water drawn daily from the Thames has gradually increased since 1856, until in 1866 it amounted to 46,977,228 gallons. The estimated number of persons now supplied by these companies is 1,369,000. The committee estimate that if the population should double within the next sixty years the supply of water required *at the present* rate per head would not exceed 100 million gallons. The committee satisfied themselves that "the smallest quantity of water known to "flow down the Thames at the source of supply, in the driest "time on record, exceeds 350 million gallons in a day; that "the maximum flow in time of flood exceeds 25,000 million "gallons; whilst the daily average flow in dry seasons may be "estimated at 500 million gallons." The committee, therefore, report, evidently from the evidence of Mr. Bailey Denton, "that if, at any future period, the increase of popula- "tion should render it necessary to make provision for a "greater supply of water than could be conveniently drawn "from the Thames in dry seasons, it could be made by "storing in reservoirs in the valley of the Thames a portion of "the flood water, *which now yields in a single day a sufficient* "*supply for a whole year.*"

With respect to the quality of the water, the committee report that a very decided improvement since 1851 is shown by the regular examinations of analytical chemists officially employed for that purpose. The diminution in the amount of organic matter amounts to one-half of the quantity found in 1851, and this is not an accidental or average result, but uniformly observed throughout the year; but the committee dwell on the necessity of securing water from impurity which chemical science may fail to detect, by excluding sewage and other known sources of contamination. By a Bill passed in the present session, an authority has been created charged with the duty of preserving the Thames from pollution of sewage between London and Oxford. The committee recommend that representatives from the water companies drawing their supplies from the Thames, and one from the Metropolitan Board of Works, should be added to the Board charged with conservancy of the Thames, in order that the water supply of the metropolis may be actively protected by those most interested in the purity of the supply. The committee report decidedly against the comprehensive schemes of Mr. Hemans (they do not mention any names), and other engineers naturally anxious for a great work to do, considering "that both the quantity and the quality of the water supplied "from the Thames is so far satisfactory that there is no ground "for disturbing the arrangements made under the Act of "1852," and that to go to Wales or Cumberland or the sources of the Severn, "would only entail a waste of capital "and an unnecessary charge upon the owners and occupiers "of property in the metropolis."

We pass over, at any rate for the present, the description of the works of the New River and East London Water-Works Companies, which the committee consider capable of being made equal to any probable demand upon their supplies. Satisfied as to the quantity and quality of water which the companies will be able to supply when certain works now sanctioned or ordered are executed, the committee proceeded to consider the question of constant supply. Into this question they enter in very elaborate detail, but their views may be gathered from the following passages of the report:—"The "difficulties of affording a full supply without waste are much "greater than might be anticipated, and the difficulty of "effecting a change from any system of domestic supply "already established is even greater." The Act of 1852 is so framed that the introduction of the constant supply system cannot practically be forced from the companies. "Water is "now turned on for a short time in each day, except Sundays, "when no supply is given. Cisterns for storing water are a "more fertile cause of impurity than any pollution of the river "from which water is drawn. The committee therefore re- "commend that the Act should be amended by providing that "every company should afford a constant supply of water to "each house, so that the water may be drawn direct from the

"company's pipes at all times during the 24 hours, with cer-"tain special exceptions." They observe, however, that this recommendation cannot be carried into effect unless adequate provisions are also made to prevent waste of water! We must defer to another occasion the committee's remarks on this important and difficult question.

THE COAL SUPPLY OF DIFFERENT COUNTRIES.

Second Notice.

(*Continued from page* 170.)

Roman States.—There are no coal-fields in the Roman States. The annual imports of coal from Great Britain average 11,161 tons, and from France and Tuscany 9000 tons.

Russia.—In the report by Mr. Locock, dated from St. Petersburg, July 12, 1865, a comprehensive view is taken of the whole coal-fields of Russia, which he considers are larger than those of any country in Europe, though little has yet been done in working them. In the Ural Mountains, in the neighbourhood of Moscow, and in the regions bordering on the Don, wide tracts abounding in coal are said to exist; but it is only here and there that coal-pits have been sunk. In the Ural district, coal has been found in numerous places both on the western and eastern sides of the Ural Mountains. It lies chiefly in two strata—the one high on the mountains, the other near to the plain. On the banks of the river Ural coal has been worked to supply the factories, which have consumed all the wood near the spot; and more than 20,000 tons had already been obtained. Iron is also found in the immediate neighbourhood. The coal district of which Moscow is the centre covers an area of 400 miles long by 300 broad, and on the north it extends in a long line to the east of Archangel. The coal is, however, of inferior quality, and lies several hundred feet deep in a stratum of bluish clay and sand. In some parts this coal is stated to be highly combustible, and burns spontaneously when heaped together in the open air. Experiments have shown it to be composed as follows:—Gas, 43·29 to 58·30; carbon, 31·19 to 41·91; ashes, 10·51 to 11·47. Its value compared with Newcastle coal is estimated in the proportion of 5 to 8. Mr. Locock says—"It may be em-"ployed for the production of steam, and in salt and gas "works; but it is useless for smelting." Its price at the pit's mouth was from 4s. 8d. to 5s. 6d. per ton. In the governments of Toula and Kalouga a species of coal, called Russian Boghead, has been found in 23 places. It is of a brownish colour, without lustre, and not compact. It burns with a long red flame, and leaves much ash. It is said to have been employed in the gas-works of Moscow without success. The coal region of the Don covers an area 180 miles long by 100 miles broad. The strata have been much disturbed by faults, and the coal is of various qualities. The analyses of some specimens show the proportions of carbon to gas to be as 90·80 to 6·62, and in others 72·30 to 17·94, the quantity of sulphur being 5·45, and the ashes varying from 1·14 to 10·30, while the heating power varies from 6491 to 7705. From this district, in 1863, as much as 6,350,000 tons are said to have been produced. Coal has also been found in small quantities in the Caucasus, the Crimea, and in some other parts of the empire, including Poland. The importation of coal into Russia had tripled between the years 1857 and 1864, the total quantity imported in the latter year having amounted in value to 4,828,106 roubles, the whole of which, with the exception of 300,000 tons, was derived from England. The average price of English coal at the wharves in St. Petersburg, in 1865, is stated to have been 16s. per ton; and for ordinary consumption the cost of the heating power of coal and wood was estimated to be equal. At Moscow, the price of wood was the same as at St. Petersburg, but the price of foreign coal was £2 per ton. In consequence of the preference of wood as fuel for domestic use, it is considered that the import of foreign coal is likely to be confined to St. Petersburg. A subsequent report by Mr. Drummond, dated from St. Petersburg, Dec. 25, 1866, differs very materially from the foregoing account of the quantity of coal imported. It is stated that, in 1865, the total quantity amounted only to 554,858 tons, and the value is said to have been equal to 1,726,366 roubles, or £222,988, the proportion of English coal being about three-fourths of the whole. Both accounts profess to be taken from official returns, yet it is not probable that the importation in 1865 should have diminished so greatly compared with 1864, more especially as it is stated that "from 1863 the annual "trade has remained much the same." In a description of the coal-fields of Russia by General Helmersen, inclosed in Mr. Drummond's report, it is stated that there are many seams of coal of excellent quality in the district of the Don, some of which lie near the surface, and that at present the coal-pits of Groucheoka supply with anthracite the Russian steamers navigating the Don, the Black Sea, and the Sea of Azof. Analyses are given of specimens of coal from various districts; and, in a comparison of the coal of Lisitshansky, one of the best bituminous kinds, with that of Lancashire and of Epinas in France, the results are stated to be in 100 parts of the Russian coal, 75·97 of carbon, 5·42 of hydrogen, 13·2 of oxygen, and 4·12 of ashes; in the Lancashire coal, 72·86 of carbon, 4·98 of hydrogen, 9·22 of oxygen, and 11·40 of ashes; and the Epinas coal, 80·00 of carbon, 5·10 of hydrogen, 13·36 of oxygen, and 2·53 parts of ashes.

Saxony.—The general condition of the coal-mines in Saxony is reported to be highly satisfactory, but the accounts are not to a later date than 1863. The principal mines are situated in the neighbourhood of Zwickau, and though the number of pits had only increased from 82 to 87 during the last ten years, the produce had more than doubled. The total production of coal in Saxony in 1863 amounted to nearly 2 million tons, and the exports to 390,000 tons. The only coal imported consisted of brown coal, the quantity of which amounted to 100,000 tons. About an equal quantity of the same kind of coal was exported, the produce of which is not included in the preceding statement. There is a considerable number of pits in Upper Lusatia, on the left bank of the Elbe, for the production of brown coal, nearly the whole of which is consumed in the neighbourhood. The principal coal-mines in Saxony are private property, or belong to public companies; those that were in possession of the crown had not increased their produce for several years.

Sweden.—The returns from this country are very meagre, and somewhat contradictory. They reach only to 1863. The coal-mines of Sweden yield but a scanty supply, and the coal is of a soft laminated kind. The annual produce of the principal mine was only 30,000 tons. Coal is but little used in Sweden for domestic purposes, and it is only of late years that it has been employed in the larger iron-works and foundries; but the rapid extension of gas lighting has opened a new source for the consumption of coal. Stockholm was first lighted with gas in 1856, and since 1855 the quantity of coal imported, almost exclusively from England, has increased from 5,426,000 tons, to 15,584,000 in 1863, and the consumption is increasing every year. The coal shipped from England is generally taken out as ballast in vessels chartered for return wood cargoes.

Switzerland.—The great geological changes which have occurred among the carboniferous strata of Switzerland have nearly denuded that country of coal. The oldest known traces of coal are confined to the central and western Alps, where beds of anthracite of very good quality have been worked. Slate coal is found in the cantons of Vaud, Zurich, and St. Gall, but of inferior quality. "Real coal" has only been found in the cantons of Berne, Fribourg, and the Valois. The mines of the former canton produced an annual yield of 810 tons, but the cost of extraction amounted to 20s. per ton, and with the introduction of railways and the reduction of the price of imported coal the working of the mines had become unprofitable. The quality of this coal is stated to resemble the superior kinds of Newcastle coal. The Bernese Gas Company, however, it is said, found it more advantageous to extract their gas from wood than from the coal. The total quantity of coal imported in 1864 amounted to 200,000 tons, derived almost entirely from France.

Turkey.—The only coal-fields worked in Turkey are at Bender-Erekli, on the southern coast of the Black Sea, about 90 miles from the Bosphorus. The coal is extracted by burrowing into the sides of the mountain. It is generally of inferior quality, but some of the coal produced at Kozloo is said to be very good for the manufacture of gas. A rich vein of coal is supposed to extend from Bender-Erekli to Selsni, a distance of upwards of 170 miles, but no intelligent method of working it has been adopted. The largest quantity of coals extracted annually from the Bender-Erekli neighbourhood has not exceeded 30,000 tons during the last six years. Turkey imports about 200,000 tons of coal annually from Great Britain, and about 2000 tons from France.

Wurtemburg.—No coal exists in this country, and the

largest portion imported comes from Westphalia. Of English coal very little is used, on account of the expense of conveyance; but a few tons of what is called by the secretary, Mr. Cobbold, "bucket coal," are said to be imported by private companies from England for manufacturing gas. The total quantity of coal imported in 1864 amounted to about 160,000 tons.

Africa.—The accounts of travellers into the interior of Africa mention vaguely coal as one of the natural products they have discovered, but there is no authentic information of the existence of coal-fields on any part of that continent. The only reports in these returns relating to Africa are from the consuls at Alexandria and Morocco. The imports of coal into the former port in 1864 amounted to 303,651 tons, and in the previous years to 327,197 tons; the quantities of coke imported in the same year having been 27,967 and 59,873 tons respectively. They were imported exclusively from England. The consul at Tangiers reports that before 1863 no coal was imported into Morocco; but in 1864 the quantity imported amounted to 530 tons principally for the use of recently erected steam flour-mills.

Asia.—From this quarter of the globe the consular returns of the supply of coal are most scanty and unsatisfactory. Consul Taylor reports from Diarbekir and Kurdistan, that he has "seen near Jezireh, in the mountains, 30 miles from the "Tigris, a very fair description of coal." From Turkestan it is reported that coal had been discovered in the mountains of Karatousk, and in other places near Tarkhend. At Nazli, about 80 miles from Smyrna, there are stated to be mines that produce tolerably good coal, and other mines are mentioned from which coal of an inferior quality is extracted.

South America.

Throughout the greater part of the continent of America coal is found, but it is in the North that it more particularly abounds. Of the South American coal-fields, indeed, little is yet known, and such information as the consular reports afford is generally of a vague character. We shall, however, first dispose of them before considering the more important coal productions of the North.

Argentine Confederation.—There are not supposed to be any coal-fields within the limits of this Confederation. The total quantity imported in 1864 amounted to 19,303 tons, of which 15,598 tons came from England. Of that quantity 5831 tons were imported duty free, and set apart for the use of railways and gas-works. The price of coal at Buenos Ayres in July, 1865, was £6 per ton.

Brazil.—There are no extensive workings of coal at present in Brazil, but coal is known to exist there in considerable quantities, and the reports given by Mr. N. Plant, Professor Agassiz, and the late Mr. Ginty, engineer of the Rio de Janeiro Gas Company, of the coal-mines on the river Jaguarão, are most promising of future produce. It appears from a geological survey of the district by the former gentleman that the coal strata cover an area about 50 miles long by 30 miles broad, and that there are three distinct beds of workable coal within a short distance from the surface. The upper one, which is 3 feet thick, is of an inferior kind, and contains a large quantity of ash. The second one is a seam of bituminous coal, 17 feet in thickness, which is stated to be well adapted for steam fuel, and to resemble the Cardiff coal. The lowest seam of coal, which is separated from the former by a narrow band of blue clay, is 25 feet thick, and it is of superior quality to the others. It has been used as fuel in a variety of ways with marked success, and in Mr. Ginty's opinion it would supply good gas coal. The fossil plants accompanying the coal closely resemble those of the regular carboniferous system in this country, and confirm the impression that this coal-field will prove extremely valuable when properly worked. It is accessible by water, though it is a considerable distance from any port of exportation. One of the principal features of this coal deposit is, that it presents great facilities for working the coal by open quarrying on an escarpment whereon there is an outcrop of coal strata of 65 feet exposed along the margin of a river valley. Specimens of the coal accompanied the report, which are placed in the Geological Museum. The Brazilian Government last year imported 200,000 tons of coal for gas and steam purposes, which was sold at Rio de Janeiro at 45s. per ton, but it is estimated that when the mines of the river Jaguarão are opened coal will be reduced to less than one-half that price.

Central America.—Coal of fair quality has been found at one part of this State on the southern branch of a river that runs into the Atlantic at Costa Bay. It is of the kind known in Germany as brown coal. There is no trade in the import or export of coal in Central America.

Chili.—Coal is obtained in considerable abundance in some parts of Chili (Coronel and Lota), and is sold at Coquimbo, on shore, at 9 dollars a ton. It is said to be a free burning coal, and by a peculiar arrangement of the fire-grate it answers well for smelting and steam purposes. English coal costs about 10 dollars a ton, and it is mixed with advantage with the native coal.

Mexico.—Though Mexico constitutes, geographically, part of North America, it is assimilated, in general character, with the Southern States, and it may, for our present purpose, be classed with them. No coal-mines have been worked in any part of the country, though there is reason to suppose coal exists in several districts. Some coal discovered in St. Luis de Potosi is described as being of excellent quality. About 500 tons are imported annually at Matamoras for the use of cotton-presses and steam-tugs.

Monte Video.—There are no coal-mines in this republic, nor are any workable seams of coal supposed to exist. The import of coal, derived almost entirely from Great Britain, has increased, of late years, at the rate of 15 per cent. per annum.

(To be continued.)

Circular to Gas Companies.

After all the threatening indications of failure, there is at length some chance of the passing of an Act this session for the amendment of the Metropolis Gas Act of 1860; unless, indeed, the original promoters of the Bill, but now its determined opponents, factiously resist its further progress. The extraordinary change that has occurred in the relative positions of the gas companies and of the Corporation of London and the Metropolitan Board of Works, with regard to the Bill, can be best explained by tracing the course of proceedings since our last publication. At that time the further progress of the measure seemed to depend on the agreement among gas companies on some scheme of amalgamation, without which it was stated that the committee would not pass any one of the Bills submitted to them, but would make a general report to the House, as a guide for future legislation. When the committee reassembled on the 9th inst., Mr. Hope Scott, on behalf of the companies, made some propositions involving further concessions, to the effect that they would supply 14-candle gas at the maximum price of 4s. per 1000 feet; that, to meet the wishes of the committee, they were prepared to effect amalgamations and a rearrangement of districts, and to agree to the appointment of a public auditor, so that the extent to which reductions of price might be made consistently with the maintenance of the prescribed dividends might be placed beyond dispute. Mr. O'Malley and Mr. Grove, on behalf of the Corporation and of the Metropolitan Board, considered those propositions unsatisfactory, and the committee adopted unanimously the following resolutions:—

1. That the committee are not satisfied with the offer made on the part of the companies to supply gas to the metropolis at the price of 4s., with an illuminating power of 14 candles.
2. That they are prepared, with the consent of the parties, to insert in the present bill a price which, after making adequate allowance for reduced expenditure, shall be calculated to yield, with due care and management, a dividend attaining, or at least approaching, the maximum dividend of the Act of 1847 upon the amount of the share capital already expended under the authority of Parliament. In this case they will insert also in the bill machinery for the periodical revision of the price, in conformity with this principle.
3. Failing the acceptance of these proposals, the committee will report to the House their opinion that powers for the supply of gas ought to be conceded to the local authorities of the metropolis.

The committee adjourned for two days, to allow the parties to consider those resolutions, but no standard of illuminating power and price could be agreed upon; and after some observations from the chairman, adverse to the gas companies in the sense of the third resolution, the committee, at the request of Mr. Davison, adjourned, to afford another opportunity for consideration. On the following day a further application for adjournment was made, on the ground that there was a prospect of an arrangement being arrived at with the Board of Trade by the gas companies. When the committee reassembled on Tuesday last, letters were read which had passed between Mr. Baxter, the solicitor for the gas companies, and Mr. Wyatt, on

behalf of the Board of Trade, respecting terms of an agreement subsequently embodied and agreed to, against which the counsel for the Corporation and the Metropolitan Board strongly protested; but nothing definitely was arranged until the next day, when the following "Heads of Arrangement with the Board of Trade, amended 18th July," were read:—

1. Present prices to be charged by each of the companies until the 1st of January, 1869, subject to the opinion of the committee as to the continuance of an additional 3d. in outlying districts.

2. The illuminating power from the 1st of October, 1867, till the 1st of January, 1869, to be not less than 14 candles.

3. After the 1st of January, 1869, price to be 3s. 9d., subject to the provisions hereinafter contained.

4. The illuminating power after the 1st of January, 1869, to be 16 candles.

5. From the 1st of January, 1870, and so on from year to year, on request, either by the local authority or by the companies, an arbitrator to resettle the price and illuminating power (to be in no case less favourable to the public than under the Act of 1860) on such a footing as will on the one hand secure to the public the lowest price and highest illuminating power consistent with the payment of the dividends prescribed by the Act of 1847, or any special Acts of the several companies, and will on the other hand enable the companies, with due care and management, to make up such dividends, including penalties charged to dividends, but excluding any sums taken from reserve-funds.

6. If on any two successive days at any time, or on any twenty or more days in any period of sixty successive days, the gas supplied by a company from any station is of less illuminating power, or of less purity than it ought to be under this Act, the company shall in each case forfeit a sum of £50 to the Crown, and the same, if not paid, shall be deemed a debt due from the company to the Crown, and shall be recoverable accordingly with costs; and such forfeiture should be borne and paid (to the satisfaction of the auditor appointed as in this Act provided) exclusively by and out of the profits of the company applicable to the purposes of dividend, and by way of reduction of dividend. Provided that such forfeiture shall not be incurred in any case in relation to which it is certified by the chief gas examiner that the defect of illuminating power or excess of impurity was occasioned by an unavoidable cause or accident.

7. The arbitrator shall be appointed by the Board of Trade, and his decision shall be given after hearing the companies and the local authorities.

8. Forthwith after the passing of this Act, the companies shall take proceedings to effect an amalgamation, with a view to there being not more than four companies, and shall report the result to the Board of Trade, who may hear any objections and suggest amendments; and if the companies do not adopt such suggestions, the same shall be heard before and determined by the Queen in Council, and the amalgamation so settled shall be final and binding as if enacted by Parliament. If no amalgamation, &c., be reported within six months, the Board of Trade to appoint three commissioners to effect amalgamation on the like principle as to number of companies, with full powers to examine books and officers and other necessary and proper powers, and the scheme of the commissioners to be final and binding as if enacted by Parliament. Amalgamation may comprise proper compensation to holders of abolished offices.

Mr. O'Malley and Mr. Grove again declaimed against such an arrangement, contending that it had been made between the gas companies and the Board of Trade without any consultation with the City authorities and the Metropolitan Board, and that it would be much better for the public that the Bill should not be proceeded with than it should be passed with such provisions. Mr. O'Malley protested against the supposition that the Board of Trade were acting in the interest of the public, and said they were acting in the interest of the last clause of the Bill, which provided that the expenses of it should be paid by the Metropolitan Board, and not by the Board of Trade, who were the promoters. The chairman told Mr. O'Malley that the committee were of opinion that he was not acting in his own interest by the objections he made; and the learned counsel for the City was so pertinaciously obstructive to the progress of the Bill in the subsequent discussions, that the chairman was on several occasions obliged to interfere. It was after some discussion agreed that the "heads of arrange-" ment" should be incorporated in the Bill, and in the expectation of bringing the proceedings to an end the committee met on Saturday, when the clauses of the amended Bill were considered; but after sitting from half-past ten till four there were several points left unsettled, and a further adjournment took place until this day. The Bill in its amended form differs very materially from the Bill as amended by the House and presented to the committee. The first operating clauses relate to the amalgamation of the companies, as specified in the eighth head of arrangement. The powers to be exercised by the "Metropolitan Gas Board" are not materially changed, but the title is altered to that of "Metropolitan Gas Referees." All the clauses relating to the illuminating power and the price of gas have been altered in accordance with the heads of agreement, the question of the price of cannel gas having been postponed. The consideration of the following matters was also postponed:—The compensation to officers whose services may not be required after amalgamation, penalties, arbitration, pressure, governors for public lamps, the limit of charge for gas supplied to local authorities, the settlement of differences by arbitration, and the remuneration of the commissioners, gas referees, auditor, and chief gas examiner. These questions will fully occupy the time of another sitting of the committee, even should the counsel for those who are now the opponents of the Bill interpose no vexatious objections. During the 22 days that the inquiry has continued, the committee—the chairman most especially—have manifested a highly praiseworthy desire to arrive at an equitable settlement of the matters submitted to them, and they have conducted the proceedings with great patience, fairness, and ability. Though some of their resolutions were apparently adverse to the gas companies, they were, according to their view of the circumstances, in conformity with the conditions on which the companies consented to the second reading of the Bill, and the latter might have left the committee to decide the terms of the supply of gas to the metropolis without fear of their rights being prejudiced. The justice and sound policy of the decisions of the committee are generally admitted, and the firmness with which, on the one hand, the taunts and menaces of Mr. O'Malley were suppressed, and, on the other hand, pressure was applied to the companies to induce them to conform to the views of the committee, exhibited the forbearance and skill with which this prolonged campaign has been conducted; for a campaign it has been, under the guidance of the greatest leaders of parliamentary strategy. Mr. Cardwell was not blinded by the clouds of figures heaped upon him from both sides, but, with a keenness of perception for which he is eminently distinguished, he quickly separated the wheat from the chaff, and dispelled the mist which would have obscured the vision of most other men.

The Metropolis Subways Bill has passed the committee of the House of Commons, but in such a form that will, we conceive, prevent the further extension of subways in London or elsewhere. When the committee reassembled on the 9th inst., after the experiments suggested by Dr. Percy had been made in the subway in Southwark Street, witnesses were examined who described the character of those experiments and their results; but though they agreed as to the facts, the inferences drawn from them by the two classes of witnesses were directly at variance. Dr. Frankland stated that the experiments consisted in making apertures in the top of the gas-main, midway between two ventilators, and after allowing the gas to issue for a quarter of an hour, and in some experiments for a longer time, the per-centage of gas at the top of the subway was ascertained by Dr. Ansell's indicator. The apertures in the last experiments were one inch and a half in diameter, and ultimately the pipe was severed, and as much gas was allowed to escape as possibly could. In no case, however, did the proportion of gas to air exceed 3 per cent., and the per-centage of gas did not increase after the first ten minutes. These facts confirmed Dr. Frankland in the opinion that it would be almost impossible, under any circumstances, for the gas to accumulate in the subways so as to be dangerous. Mr. Dugald Campbell and Mr. Ansell corroborated Dr. Frankland's account of the experiments, and agreed with him that there could be no danger from any escape of gas that could probably occur. Dr. Letheby, Dr. Odling, and Mr. Hersey, on the other hand, while agreeing with the preceding witnesses respecting the facts of the experiments, were of opinion that they were unsatisfactory. It was asserted that though the main which was opened was 18 inches in diameter, its only supply of gas was derived from two pipes of half an inch diameter; and it was calculated that if the whole of the gas had escaped into the subway during the time of the experiments, it would not have amounted to more than 2½ per cent. Mr. Hersey, the inspector of the Imperial Gas Company, also gave evidence to prove that subways would not be of great advantage even so far as regards the breaking open of the streets, for the streets must be broken open to introduce the gas-mains into them; and he stated that when the mains of their company in Portland Road had been recently examined, only 11 joints in upwards of 1000 had been found at all leaky, though they had been in the ground upwards of 40 years. On the following day Mr. Denison summed up the case on behalf of the opponents of the Bill. He contended, in the first place, that, considering the money proposed to be expended and the inconvenience to be remedied, there was no foundation for passing the measure, for it could not cure the alleged evil except at a cost of £20,000 a mile, and that evil itself was practically nothing. He said that if the committee passed the preamble of the Bill, the opponents would not discuss the clauses, but reserve further opposition for the committee of the House of Lords, and that the only terms on which they could entertain the

question would be, that the Metropolitan Board should take the whole of the risk, and have the control of laying the mains in the subways, and that the gas companies should have the use of them on the same terms as they have now the use of the streets, on payment of the rates. That, he said in concluding his speech, "is a right which they have got, and "that right is as great as your right to the coats upon your "backs. Nobody has yet been deprived by Parliament of the "possession of a right of that sort, and if you pass this Bill "on any such terms as the Metropolitan Board seem inclined "to take it upon, you will be for the first time doing that "which Parliament has never for a moment listened to yet." Mr. Rodwell addressed the committee in reply, after which they adjourned to the following day. The speech of Mr. Denison had evidently produced an impression on the committee, and on resuming proceedings the chairman stated that they were prepared to pass the preamble of the Bill, subject to the introduction of provisions to the effect that the operation of the Act should be limited to the subways already constructed or in the course of construction; that no rent shall be chargeable; that supervision shall be provided by the Board of Works; and that the cost of removing the pipes from any existing street into the subways shall be defrayed by the Metropolitan Board. The gas companies, however, refused to accept that concession unless they were also exempted from any risk that might arise in consequence of the subways not being in a complete state of ventilation, or from any responsibility for what might arise in consequence of the pipes being laid in the subways. The committee expressed their intention to introduce a clause for securing efficient ventilation in the subways, but that proposition alone was not considered satisfactory, and when the chairman stated that the committee had unanimously decided that the preamble of the bill was proved, the gas companies withdrew, reserving further opposition for the House of Lords. The clauses were then agreed to, and the Bill, as amended, was reported to the House. In its present state it would compel gas or water companies to lay their mains in any subway constructed or in the course of construction, on notice to that effect by the Metropolitan Board of Works. If they break up a street wherein there is a subway to lay down any pipes, they would be liable to a penalty of £20 for every offence, and the Metropolitan Board might remove any pipes so laid at the cost of the companies. All the pipes placed in subways are to be maintained by the companies, under supervision by an officer to be appointed by the Board, and it is provided that the subways shall be maintained by the Board in an efficient state of ventilation and repair, and free from water or other obstruction; the terms on which the supervision is to be exercised to be agreed upon, or settled by arbitration. The cost of removing mains from the streets into the subways, where required, is to be defrayed by the Board. The obligation to keep the subways efficiently ventilated substantially throws the responsibility of damage caused by explosions on the Metropolitan Board, unless negligence be proved on the part of the gas companies, who might thus rest satisfied without any more explicit provision to exempt them from risk. If the public choose to pay the enormous sums which the construction of subways requires, for the sake of being relieved from the temporary inconvenience of having the pavement of the street disturbed, and are willing to incur the risk of explosions, it is not for the gas companies to interpose; but we apprehend it would soon be found that the advantage would be too dearly bought. So long as there was a chance of getting a rent from the occupiers of the subways sufficient to pay the interest on the expenditure, the Metropolitan Board had some excuse for expending the ratepayers money in such constructions; but now that chance has vanished, and the subways are to be occupied by gas and water companies without payment, the Board will not feel inclined to waste more money in extending them.

The liberal proposals made by the gas company of Cheltenham to the Improvement Commissioners of that town, as mentioned in our last, have been accepted with trifling modifications, and the long-pending dispute between them may be considered as amicably settled. The company proposed to renew the contract for lighting the town for one or for three years, on the conditions that the price charged for gas should be 3s. per 1000 feet, to be supplied by meter if required; that the charge for lighting and extinguishing the lamps, including their use and maintenance, should be reduced to 14s. each per annum; that the time allowed for lighting and extinguishing should be limited to 55 minutes per day; that a uniform burner should be provided by the company, subject to the approval of the commissioners; and that the minimum illuminating power of the gas, tested at the works by the parliamentary Birmingham burner, should be 13 candles. The commissioners had required that the illuminating power should be 13½ candles, tested at their office. It is satisfactory that the differences between the company and the commissioners have been at last settled, and that the state of antagonism which has so long existed has terminated, though the object has been attained at considerable sacrifices by the gas company, who have evinced throughout the negotiations great forbearance, and a strong desire to meet any reasonable request made by the commissioners.

An alleged case of nuisance was tried at Warwick Assizes last week, in which Mr. Dyson, the owner of some cottage property at Saltley, near Birmingham, sought to recover damages from the Birmingham and Staffordshire Gas Company for injury sustained by the effluvia issuing from their works at that place. Several of the witnesses stated that the stench of the lime drawn from the purifiers was most offensive, that the white paint in the cottages was discoloured, and that the occupants had suffered from sickness and loss of appetite in consequence of the effluvium issuing from the works. It was also stated that the value of the property had been greatly deteriorated since the gas-works had been erected, and that the plaintiff had been compelled to reduce the rents of the cottages to prevent them from being void. Two scientific witnesses gave evidence of the disagreeable smell generally emitted by "blue billy," but they did not aver that they had been annoyed by it on visiting the works at Saltley. On behalf of the defendants three scientific witnesses were called, who spoke of the excellent arrangements of the gas-works for the prevention of nuisance, and that the smell of sulphuretted hydrogen when the purifiers were charged was not perceptible at a distance of 100 yards. Occupiers of the cottages were called, who said they had not experienced any inconvenience from the proximity of the works, and that the smell they occasionally perceived proceeded from other manufactories in the neighbourhood. It was stated also that the rents received for the cottages were equivalent to their full value, and that none of them were void. Mr. Justice Lush, before whom the case was tried, told the jury that, in order to sustain an action of that kind, there must be a real and permanent nuisance, and that an occasional smell from the works was not sufficient. The jury, without hearing the counsel for the defendants, said they had made up their minds to return a verdict in their favour, but the counsel for the plaintiff elected to be nonsuited, so as to enable his client to have the case tried again if he thought it desirable. There was another action, in which a Mr. Charles sued the same defendants on similar grounds, but the record was withdrawn, and the plaintiffs in both cases will have to pay the costs. The real object of the plaintiffs appears to have been to compel the gas company to purchase the properties. We regret that no notice was given to us that these important actions were to be tried, so as to enable us to have them fully reported, the notices of them in the local papers being unsatisfactorily brief.

The actions brought against the Chartered Gas Company for damages sustained by the fire at Saville House, have ended in a compromise, by which the company agree to pay half the actual damage sustained, each party paying his own costs. Mr. Pownall, the surveyor, is to assess the amount of damage in case of any dispute.

Communicated Article.

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GAS AND WATER APPARATUS AT THE UNIVERSAL EXHIBITION OF 1867.

(*From our Special Correspondent*).

Without wishing to enter here into a general description of this wonderful Exhibition—the gigantic work which has been accomplished by the Imperial Commission during a few months, and which has far surpassed all previous exhibitions—some figures will be sufficient to give an idea of its vastness. The area of 37 acres occupied by the palace and its adjuncts in 1855, and of nearly 31 acres in the International Exhibition of 1862, has been extended in 1867 to nearly 99 acres, more than one-third of which space is covered by the palace. The number

of exhibitors, which in 1855 amounted to 22,000, and in 1862 to 28,000, has been increased this year to 60,000. The weight of the products exhibited cannot be estimated at less than 28,000 tons. The communication established between the palace and the continental railways has afforded the means, which could not otherwise have been procured, of conveying and placing this enormous quantity of objects. The steam power for putting the machines in action is equal to more than 1000 horses. The quantity of water provided is sufficient to supply the wants of a town containing 100,000 inhabitants. It must be admitted that the building, though often adversely criticized, is very well adapted to its purpose. The necessary conditions of a distinct and methodical classification of different nations and their products could not be sacrificed to the attempt to produce a monumental appearance, and vast aisles would rather have concealed the objects exhibited than have placed them in relief in their proper places. We admire the bold dimensions of the circular galleries *sillonnées* by a platform which separates the public from the machines that bear witness to the great degree of perfection which our manufactures in iron have attained. Visitors flock to the places where the operations of manual labour are conducted, where the skill of the workman is seen to transform crude materials ingeniously into a variety of objects, and to strive for superiority with machinery in perfection and rapidity. We admire the galleries of the history of labour, rich with treasures borrowed from public and private collections; the park, with its working towns, the representations of the constructions of different countries, so original and so picturesque; and the private (*réservé*) garden, that improvised paradise; the measures taken to profit by the vicinity of the Seine, which animates these varied scenes with the waters of the river bearing on its surface the pleasure-boats with outspread sails; and, lastly, the exhibition of Billancourt, where the farmer may see in operation the machines which interest him, and examine the different systems exhibited.

Let us, however, direct our attention to that part of the palace which is most deserted, where there are collected together the elements of all the riches of the globe, and let us examine the matters that especially interest us—viz., the processes and apparatus for gas lighting.

The Imperial Commission adopted the following system of classification:—

Group 1.—Works of art (Classes 1 to 5).
„ 2.—Materials and applications of the liberal arts (Classes 6 to 13).
„ 3.—Furniture, and articles intended for houses (Classes 14 to 26).
„ 4.—Clothing and other articles worn on the person (Classes 27 to 39).
„ 5.—Extracted products, rough and manufactured (Classes 40 to 46).
„ 6.—Instruments and processes of ordinary arts (Classes 47 to 66).
„ 7.—Articles of food, fresh and preserved, of various degrees of preparation (Classes 67 to 73).
„ 8.—Living products and specimens of farming (Classes 74 to 82).
„ 9.—Living products and specimens of gardening (Classes 83 to 88).
„ 10.—Objects specially exhibited, having in view the amelioration of the physical and moral condition of the population (Classes 89 to 95).

The classes which interest us are:—

Class 24.—Apparatus and processes for lighting and heating.
„ 40.—Which includes metal tubes.
„ 51.—Which contains the materials and apparatus of gas-works.
„ 53.—Containing regulators, meters of liquids and gas, and gas-engines. Lastly,
„ 65.—Which contains the materials and apparatus for the distribution of gas and water.

We shall commence the consideration of the manufacture of gas, as presented at the Exhibition, by the examination of one of its most essential branches—the retorts and fire-proof products.

The progress in the manufacture of gas, which has resulted in extracting from coal all the gas it contains, has had the effect of increasing the heat of the distillation beyond 1200°, and of displacing almost entirely iron retorts, which will not resist such a heat, and of substituting for them clay retorts. Commencing with the French section, we find in the great gallery of machines, belonging to Class 51, remarkable products from several manufactories. We may mention in the first place, as specimens of the perfection of these products, the Paris Gas Company. After the fusion into one company of the different gas-works which before 1855 lighted the town of Paris, the brick-making operations hitherto conducted at the different works were concentrated into one at La Villette, close to the canal and to the railway. This company make all the things necessary for the construction of gas-ovens, and the arrangements being adapted for the production of a much greater quantity of fire-proof materials than is required for their own use, the company are in a condition to supply earthenware retorts and fire-proof materials for the works in the province. In the work of grinding and mixing the clay, and carrying it to be worked up, a steam-engine of 40-horse power is employed. The construction of the articles, which requires the greatest care, is done by hand alone, and they are baked by the coke produced in the gas-works. The number of retorts manufactured annually amounts to about 3000. Upwards of 20,000 blocks and pieces, extra fire-proof, are also made for the construction of the ovens, and a million of fire-proof bricks. This company have found the means of utilizing the ashes from the fires of the ovens, by mixing them into a composition containing one-half its weight of ashes, and which makes a very hard material for the floors of workshops, stables, &c. The manufacture of these tiles amounts to upwards of 30,000 per annum. The value of the fire-proof articles manufactured by the company in the course of a year exceeds £18,000, and about 60 men are employed in making them. This company exhibit a model, made in their workshops, of an oven fitted with seven retorts, as adopted in their works, made to a scale of one-tenth, all the pieces of which are separate, with wrought-iron lids, and the requisite appliances. By the side of this model there are retorts of the actual size used, with circular retorts for smaller works; blocks and curved pieces for the construction of the ovens; a large cylindrical tub of perfect workmanship, made of fire-proof material, 4 feet in diameter by 10 feet in height; a large fire-proof *carreau*, or tile, 8 feet long by 4 feet wide, weighing above 17½ cwt., for the bottom of the oven; paving-tiles made of the mixture of ashes; and, lastly, bricks of different kinds.

The conditions of good workmanship, which require that fire-proof goods should resist an extremely high temperature in attaining their greatest heat and in cooling, and be almost impermeable by gas, appear to be realized by the firm of L. Bousquet and Co., of Lyons, established in 1854, which has acquired great reputation. Practical experience of these retorts in all parts of France, in Italy, Spain, Switzerland, and Germany, has proved that when properly set they will last for three years, with great care. A kind of black enamel, which gives these retorts an unfavourable appearance, prevents them from being quickly burnt. Messrs. Bousquet and Co. set their retorts in the ovens by resting them only at the two ends, by which means the construction is simplified, the retorts are more directly heated, and the distillation of the coal is effected more completely without requiring so great a heat. To illustrate the advantage of this mode of construction there is exhibited a gas-retort taken from an oven where it had been in use for 18 months, and which does not seem to have undergone any change. It is to be regretted, however, that the heat to which it was exposed is not stated. The same firm exhibits a gas-retort open at both ends, which is 10½ feet long; three retorts of the ordinary kind and of different lengths; two retorts for cannel gas (as in use at Venice and Locle, in Switzerland), 5½ and 4 feet long.

Close to these two remarkable objects are placed the products of the manufactory of Messrs. E. Muller and Co. These manufacturers, who have acquired great reputation in the making of tiles and bricks, exhibit retorts and fire-proof articles of a clay which contains no iron, but presents particles of lime, which must give a degree of fusibility to their products. The *calorifères* and laboratory furnaces exhibited by them are very good.

Messrs. A. Dalifol and L. Huet exhibit a gas-oven with three retorts. By a contrivance in the moulding of the upper part, the bricks which usually support retorts are rendered unnecessary. With them there are exhibited gas-retorts, triangular tubes, which, when placed on the bottom of the retorts, produce a current of air that detaches the graphite from the sides.

M. H. Jousseaume. The retorts exhibited by this manufacturer are covered with a vitrified coating, which tends to make the earthenware impermeable by gas. We have not had the opportunity of ascertaining whether this coating resists the high temperatures to which gas-retorts are subjected.

Leaving the French section, we will enter the Belgian department, situated in the park (class 65). The beauty of the fire-proof goods exhibited there indicates that we are in the centre of the produce of good fire-proof clays. The exhibition of *La Société anonyme des Terres plastiques et Produits réfractaires d'Andennes* first attracts attention. This company, under the management of M. Bertrand, possess numerous quarries of fire-proof clays, which enable them to supply different manufacturers who use that material. They supply to glass-houses considerable quantities of clays, known for their very superior qualities for the manufacture of crucibles, pots, or bricks for the ovens. Eighty workmen and eighty horses are daily employed to extract and convey the clay to the manufactories and to places of export. The company work annually nearly 20,000 tons of clays, of which quantity produce 8000 are sent directly as materials for manufacture, and the remainder is manufactured by themselves. They have two manufactories, containing the most perfect apparatus and tools, and motive power equal to 96 horses: 220 men are employed in these two manufactories. The fire-proof articles made annually amount in weight to above 12,000 tons, representing the value of £32,000; and the annual production of crude materials and manufactured products amounts to 50,000 tons. The company have 32 large kilns. We shall not particularize here the various articles for the making of chemical products, for glass-works and glass manufactures, nor the fire-proof bricks for metallurgy; we

shall confine our notice only to the earthenware retorts. Of these this company exhibit a D retort, 10 feet long by 25½ inches, 15 inches in the opening, and 2¼ inches thick, weighing a little over 16 cwts.; an elliptical retort, 10 feet long on the outside, and 20½ by 12 inches wide, and nearly 2¼ inches thick, weighing 11½ cwts.; a D retort, 8 feet 4 inches long, 20½ by 14½ inches wide, and of the thickness of 2½ inches, and weighing very nearly 12 cwts.; and, lastly, a retort for portable gas, 4 feet 6 inches long by 2 feet 9½ inches wide, and 10 inches high, and weighing 5¾ cwts. All these manufactures deserve the great reputation the company have attained by their finished workmanship and the excellence of the materials employed.

Near the preceding is an oven of gas-retorts, exhibited by M. de Fuisseaux, of Bawdour. The whole arch of the furnace of this oven is in one piece, and bears one retort. The same piece may serve for an oven of five or seven retorts. The oven, as it is exhibited, only requires to be enclosed by a brick arch for the production of gas. The exhibitor, in adopting this arrangement, conceives that it will effect a great saving of workmanship in the construction of ovens, which would thus be made very rapidly; he hopes also to give greater solidity to the work, and to prolong the durability of the retorts. It is said that this plan has been in operation in Belgium upward of five years; but we fear that the sides of the furnace are too weak to resist the blows of the implements employed.

We have yet to mention the retorts exhibited by *La Société des Produits réfractaires de St. Ghislain*, and by Sugg and Co., of Ghent. The latter are large contractors for the supply of the different gas-works of Germany, and they exhibit the different methods of construction for the attachment of cast-iron mouthpieces.

Prussia presents, in the gallery of machines, an important contribution to this class of manufactures. Messrs. H. J. Vygen and Co., of Duisbourg, exhibit products similar to those already described. Their establishment, which is situated directly on the banks of the Rhine, was founded in 1856, and in 1866 the production of retorts, crucibles, and fire-proof articles amounted to nearly 9000 tons. In addition to the persons employed in the working of the clay extracted on the spot, this manufactory occupies about 120 workmen and three steam-engines, of the united power of 90 horses. Their products are sold in Germany, Holland, and Switzerland. Messrs. Vyger and Co. exhibit retorts of different shapes, of excellent workmanship, coated internally with an impermeable varnish. They showed us some results of trials made with their bricks compared with some of Belgian, Scotch, and English manufacture, in ovens heated probably with dead oil (from the distillation of tar). As might be expected, their bricks resisted the action of heat better than all the others, with the exception of the English. We regret that these comparisons should be made, which are of no value unless the places where the articles come from are exactly stated. In the Austrian section, in the park, are displayed the fire-proof products of the manufactory of M. le Comte Eugène de Larisch Mönnich, of Polnischleuten (Silesia), who exhibits also a retort.

Passing rapidly through the sections of Russia, the states of the south of Europe, of the East, and of America, we come to England. We must, in the first instance, express our astonishment and regret at the absence of nearly all the great manufacturers of this country. No doubt the reputation of many firms is so firmly established that they have no occasion to seek to obtain medals at Paris, but in an exhibition properly entitled universal, every nation should endeavour to show to the world the importance of its manufactures, and among them the manufacture of fire-proof products—the basis not only of gas lighting but of all metallurgic processes—deserves a first place in England. Messrs. Joseph Cliff and Son, of Wortley, near Leeds, are the only important exhibitors of such articles. They exhibit a circular and a D retort of the size usually employed in England. The internal surface of these retorts is very smooth, and is covered with a coat of silicate of alumina, which produces an impermeable varnish on the sides when the retorts are exposed to great heat. By this means the adhesion of graphite is avoided, and the duration of the retorts is prolonged, as stated by Messrs. Cliff, to three or four years. These gentlemen also exhibit a material, known by the name of "ganister," which is a very pure silicate of alumina found in the coal-fields of Yorkshire. This substance may compete with the graphite of Ceylon in the manufacture of crucibles for the fusion of metals, of which fine specimens are exhibited by the Plumbago Crucible Company in the English section.

(*To be continued.*)

Correspondence.

GAS LEAKAGE.

SIR,—Permit me, through the medium of your JOURNAL, to suggest a plan, which, if adopted, would, I think, put an end to "leakage" from gas-mains and services.

I propose that the mains should be laid under the footpath, in brick trenches or channels, and on saddles of iron or wood; that at intervals of 20 yards brick divisions should be placed across the trenches, rising to the level of the footpath, and made perfectly gas tight; the trenches to be covered with light cast-iron covers, inlaid at top with a coating of asphalte, to make them quiet and pleasant to walk upon. At regular intervals in each 20 yards outlets in the covers to be placed so that in case of leakage the passers by would detect it at once. For services, instead of laying the services in the ground, I propose to put a tube of brick, clay, iron, or wood, about twice the diameter of the proposed service, the ground to be filled in over this tube, and the service-pipe of lead to be pushed in from the brick trench end afterwards.

Any leak which might occur would be promptly discovered; there would no annoyance to the public in "repairing," since, generally, it could be done quite early in the morning, or even at night. The removal of the 20 yards of covers might be effected in a few minutes, the leak found and stopped, and the covers replaced in a very short time. The saving to the gas companies would be immense—in "leakage," in "labour," in "duration" of mains and services, and in "stealage"—since every service might be labelled at the main; and the advantage to the public would be as great, since there would be no breaking the ground to repair old services and mains, and, therefore, little or no obstruction to traffic.

There may be many objections to this system, and I think that to give publicity to it will provoke discussion, and do more to show the futility or feasibilty of it than any other method with which I am acquainted. I may that a variety of objections have occurred to my own mind, which, with a natural wish to do so, I have argued down; but I shall feel more than gratified if my fellow-managers and others should deem it worth their while to point out the shortcomings of my plan.

Leicestershire, July 10, 1867. W. J. P.

CAUTION AGAINST FIXING UNLAWFULLY STAMPED GAS-METERS.

SIR,—I was not aware, till the issue of your JOURNAL of the 9th inst., that Mr. Taunton, the ex-meter inspector, boasted he was the only person in the country who has the "required instruments" for testing meters. I always thought the Sales of Gas Act compelled the inspectors appointed under its provisions to be supplied with the *required* apparatus, duly stamped at the Exchequer; if Mr. Taunton has any other instruments that will more readily detect the inaccuracies of meters, I think, as he has so disinterestedly come forward to rescue the consumers from the rapacity of the constituted authorities, he should have his "required instruments" carefully photographed, and, with explanatory notes, exhibit them at all the railway stations for the benefit of the public.

As it appears Mr. Taunton is now affixing a seal unauthorized by any Act of Parliament upon the meters he tests, would it not be as well to warn the gas companies and consumers against fixing meters unless they have the legal stamp attached? as any mistake on their part might not only cause disappointment, but also lead them into a serious difficulty.

ANTI-HUMBUG.

Register of New Patents.

2558.—DAVID HENRY SAUL and HENRY PRITTIE ARMSTRONG, both of Islington, in the co. of Middlesex, gentlemen, for "*Improvements in means or apparatus employed in carburetting gas.*" Patent dated Oct. 4, 1866.

This invention has for its object improvements in means or apparatus employed in carburetting gas. For this purpose apparatus is constructed having a chamber or reservoir at the upper part thereof, into which chamber the carburetting liquid is poured through a suitable orifice, which is closed by a screw-cap or otherwise as desired. From this chamber the carburetting liquid descends to a second chamber through a tube, and the height of the carburetting liquid in the lower chamber is regulated by means of a float carrying a valve, which acts to close the passage through the tube when the carburetting liquid in the lower chamber has risen to the desired height, and opens a passage through the tube as the level of the liquid in the lower chamber falls. This lower chamber is provided with a perforated annular partition, in the interior of which are hung cotton or other suitable wicks, or the space may be filled with other absorbent material. The gas passes into the "carburetter" through a tube, and thence through perforations formed at the outer edge of a plate into the lower chamber. From this lower chamber its passes through the perforated annular division and circulates through the wicks or other absorbent material, and thence through a tube in the centre of the lower chamber to the burners. The lower ends of the wicks or other absorbent material are immersed in the carburetting liquid, whilst the upper portion thereof becomes saturated with the liquid by capillary attraction. A portion of the gas is allowed to pass through a valve into the upper chamber or reservoir as required, so that by pressing upon the upper surface of the liquid the gas may supply the requisite pressure to anable the

liquid to descend to the lower chamber. A gauge is also connected with the reservoir or upper chamber, by which the height of the liquid may be readily ascertained.

2581.—Abraham Ripley, of 34, West Square, Southwark, in the co. of Surrey, engineer, for "*Improvements in the construction of water-meters, which improvements are also applicable to the measuring of liquids generally.*" Patent dated Oct. 8, 1866.

This invention consists in the use of a reservoir of any convenient size and shape, and so formed as to contain a certain specified quantity of liquid. Into this reservoir is conducted the main pipe from which the supply is obtained. At the mouths of the inlet and outlet passages is placed a slide or valve in such a way that it covers both the inlet and outlet passages. When it is wished to fill the reservoir, the slide or valve is moved so as to uncover the inlet passage, still keeping the outlet closed. When the reservoir is filled, a further motion of the slide closes the inlet passage and opens the outlet passage, which communicates with the ordinary tap. The lever or handle by which the slide or valve is moved is connected with an ordinary index or register graduated as wished. At the top of the reservoir is placed a small valve, so constructed that while it permits the admission of air it prevents the escape of the water.

2598.—Hugh Forbes, of 184, Euston Road, N.W., in the co. of Middlesex, for "*Improvements in apparatus for the raising and propelling of water and other fluids, applicable likewise as a ship-propeller, motive power, fan, meter, and for other purposes.*" Patent dated Oct. 9, 1866.

These improvements consist, firstly, in a peculiar construction and arrangement of the teeth or cogs and their intermediate spaces, having reference to the more perfect gearing of the same on that part where the respective pitch circles of each drum meet; secondly, in such construction and arrangement of the teeth and spaces on the drums as will enable the teeth to fit more completely than hitherto into the corresponding spaces, and thus more effectually to exhaust the air, and likewise impede the return of the fluid which has once been raised; thirdly, in the gearing of the outer wheels on their respective pitch circles, and in conformity with the requisite motion of the drums when such outer wheels are used; fourthly, in the construction of the drum-casing, whereby that pressure of the water against the teeth which is antagonistic to the rotation of the drums in raising and propelling (or forcing, as it is often termed) is to the utmost diminished, while certain other pressure of the fluid corresponding with the rotary motion of the drums is as little as possible prevented; fifthly, in stopping the leakage, which is often considerable, from the upper part of the casing; sixthly, in providing side orifices for introducing the drums into the casing, so that they can be extracted or changed without dismounting the end covers from the drum-casing. This improved apparatus may, to a certain extent, be made self-acting and maintaining; and, further, it can be used as a motive power, and may become available for several purposes.

2606.—George William Shinner, of the Strand, in the co. of Middlesex, for "*Improvements in the means of and apparatus for utilizing sewage matters and liquids.*" Patent dated Oct. 9, 1866.

In carrying out this invention a tubular branch is formed with the main sewer, in order to convey the sewage matters and liquids to a suitable building, in which the apparatus for utilizing the same is to be arranged; such branch or branches before entering the building are passed through a reservoir, for the purpose of discharging the contents of the sewer on the occurrence of a storm or heavy fall of rain. This is effected by means of a valve in the branch, passing through the reservoir; the branch pipe then enters the building, and is connected to a hinged guiding-trough, which conducts the sewage over one, two, or more tanks of galvanized iron, having moveable strainers placed on their surfaces. These tanks are capable of being lifted out of an outer series of fixed tanks by means of chains travelling over pulleys in the roof of the building, and by winch gearing. These outer tanks or jackets are surrounded by a low dwarf wall, forming four sides of a brick tank, having a cage containing gravel; along the top thereof, around the wall, a sunken gutter is formed 2 inches below the level of the dwarf wall, in order to conduct the liquid to a fall, and underneath an upward filter-bed, through which the liquid percolates, and passes beyond on to a perforated floor, through which the liquid falls to a downward chemical filter-bed, and thence to a leading-off drain. The inner tanks, when lifted, are passed on to a tramway; they are provided with small running wheels in order to travel on the tramway, whence they are tilted over and discharge their contents into a hollow tank, and are there mixed with town sweepings, from which foreign substances have been separated; it is ultimately conveyed to a preparing-house and dried, and treated as required for use, and packed in sacks and barrels. In order to withdraw the sewage from the reservoir pumps are employed, and the sewage is conveyed to the tanks and filtering apparatus.

2647.—William Clark, of 53, Chancery Lane, in the co. of Middlesex, engineer and patent agent, for "*Improvements in heating and warming rooms and other buildings, and in apparatus for the same.*" A communication. Patent dated Oct. 12, 1866.

This invention relates to the application of an air-chamber in combination with an air-stove or heating apparatus. This chamber contains a reservoir of water, over which the air heated in its passage through the metal or other flues is caused to pass, the water being heated by reason of its position. In this manner the air is supplied with fresh oxygen and hydrogen to compensate for that which has become absorbed in its passage through the flues of the air-stove. This chamber also serves as a receiver of all impurities, and of the denser or noxious gases prejudicial to health.

2672.—John Smith, of 27, Leadenhall Street, in the City of London, engineer, and James John Rowe, of Rotherhithe Street, Rotherhithe, in the co. of Surrey, engineer, for "*Improvements in taps or cocks for regulating the flow of liquids.*" Patent dated Oct. 16, 1866.

The invention consists, firstly, in the use or employment in taps or cocks having interior circular frustrums, shells, or plugs, of a separate or loose spindle passing through a gland or stuffing-box formed in the bonnet or cover of the main body or chamber of the tap or cock, such spindle being provided with a square or other suitably formed end fitting into a corresponding recess in the shell or plug, but leaving the latter at perfect liberty to move, endure, and follow up such wear as may occur between itself and the shell into which it fits. Secondly, in taps or cocks (of the description hereinbefore referred to), the use and employment of stuffing-boxes without the ordinary loose covers or gland. Thirdly, constructing taps or cocks with spaces partially enclosing the plug chamber or recess, such spaces containing air for the purpose of equalizing the temperature, and preventing the unequal expansion of the recess and the plug contained in it.

2679.—Julius Brönner, of Frankfort-on-the-Maine, Prussia, for "*Improved fixing of draught apparatuses and their respective supports on all kinds of gas-burners, and improved gas-burners and draught apparatuses in connexion with that.*" Patent dated Oct. 17, 1866.

In order to obtain a tranquil flame by means of a draught apparatus, for instance, by a glass globe, it is requisite that the distance from the base of the draught apparatus to the beginning of the flame does not exceed a certain limit. Hitherto the supports of the draught apparatus have been screwed on the gas-pipes from which the burners project. Now since the screw-thread by which the supports are fixed is sometimes placed higher, sometimes lower on the gas-pipes, and since the height of the various kinds of burners and also the height of the various kinds of supports differs, it was a matter of chance whether a tranquil flame could be obtained by this universally employed arrangement. To remedy this defect is a material object of this invention.

This improvement consists not only in the direct fixing of the draught apparatuses and their respective supports on all kinds of gas-burners, but also in the construction of all kinds of gas-burners, which is effected in such a manner as thereby to render the direct fixing upon them of these supports possible, whether by screwing on or otherwise, and in an improvement of draught apparatus belonging thereto and hereinafter described.

This invention is especially important for all kinds of economical gas-burners, because such burners as are constructed on the principle represented in the drawings annexed to the specification—*i.e.*, so that the gas coming from a burner of a lesser opening is conducted to another with larger opening, passing or not through an intermediate layer—although giving more light than other gas-burners, produce a very wavering flame, and are unfit for most purposes if not combined in a fixed manner with appropriate apparatuses; such apparatuses have, therefore, been constructed especially for this kind of burner, and are joined directly thereto, so that only thereby these burners become of practical value.

The above-named draught apparatus are composed, first, of a bell-glass, the support of which is fixed on the burner itself; second, of a draught tube arranged above the burner, provided or not with a reflector, and also applied directly on the burner; third, of a draught apparatus, also joined directly to the burner, but which produces the ascending current of air by the heating of the air beneath the flame. In this arrangement the flame burns between two wings, which receive heat from the nucleus or black central part of the flame, and conduct this heat beneath the flame, so as to regularly heat the air, which rises in such a way as to cause a vertical current of air, which tranquillizes the flame.

2675.—Thomas Woodward, of Ledbury, in the co. of Hereford, for "*Improvements in machinery or apparatus for raising or elevating sewage, water, and other liquid matters.*" Patent dated Oct. 16, 1866.

It is proposed to construct a reservoir at the side of a river, embankment, tidal harbour, or other situation exposed to the influence of the tides, into which reservoir or receptacle the sewage matter or water to be raised is collected or stored. In the reservoir is placed a double or reverse pair of Archimedean screw-tubes, set on an oblique shaft supported in a bearing at the bottom of the reservoir, and in another fixed in the wall or brickwork of the embankment or masonry. Near the reservoir is placed a barge, caisson, or other body having considerable power of flotation for buoyancy, and yet of a considerable weight; this may be placed in an archway or recess, and should be secured by moving chains or otherwise. In the centre it supports a vertical shaft or toothed rod, which gears with a pinion set on a shaft containing a large toothed wheel, which in turn gears with a second pinion, and so on after the manner of multiplying gear, until the last toothed wheel of the series comes into gear with a pinion on the shaft of the oblique Archimedean screw tube-shaft, whereby it will follow that the rise and fall of the tidal water will cause the barge or caisson to rise and fall, carrying with it the vertical toothed rod, and turning the wheels and screw, so as to raise the contents of the reservoir. The descent of the tide lowers the barge or caisson, which, being of sufficient weight, exercises a gravitating power, and reverses the action of the multiplying gearing, causing the other screw-tube to come into play, and continuing the elevation of the sewage or water.

2685.—Alfred Vincent Newton, of 66, Chancery Lane, in the co. of Middlesex, mechanical draughtsman, for "*Improvements in the process of distilling petroleum and other oils or substances.*" A communication. Provisional protection only obtained. Dated Oct. 17, 1866.

This invention relates to the introduction of atmospheric air or gas, during the distilling process, among the vapours eliminated from petroleum, or other oils or substances, by the heat applied to the still. It consists in heating the air or gas, previous to its admission among the vapours, to a temperature equal, or thereabouts, to that of the oil in the still, by the same means or medium employed to heat the still, and in such manner that the temperature of the air or gas ad-

mitted increases or decreases with the temperature of the oil in the still, whereby the process of distillation is accelerated and kept under perfect control, and there is obtained from petroleum a nitrogenized hydrocarbon oil of a non-explosive character, and of superior illuminating power. It also consists in the employment of the waste heat from the still for the preparatory heating of the air or gas to be admitted to the still, prior to its being subjected to the final heating by the same means or medium by which the still itself is heated.

2733.—James Greenshields, of Glasgow, in the co. of Lanark, N.B., crude oil distiller, for "*Improvements in making gas and coke.*" Provisional protection only obtained. Dated Oct. 23, 1866.

This invention has for its object the making of gas and coke of a superior quality in a very economical manner; and it consists in employing a peculiar combination of substances of comparatively small cost. The substances to be employed in carrying out the invention are—first, shale; second, paraffin, tar, or pitch; third, lignite or brown coal; fourth, common coal; fifth, sawdust; sixth, peat.

2734.—Robert Hollingdrake, of Stockport, in the co. of Chester, ironfounder, for "*Certain improvements in the construction of metallic pipes or tubes to be employed for the purposes of heating buildings and for extinguishing fire therein.*" Patent dated Oct. 23, 1866.

This invention relates to a novel construction of such pipes or tubes as are employed for heating rooms or buildings by steam, and is designed to obtain sufficient heat with an economy of steam, and also to render such pipes available for the extinguishing of fires occurring in the rooms. The improvements consist in dividing the pipes longitudinally down their length by means of a "midfeather" or division plate, so that the upper part only contains steam or heated air, which is sufficient to impart heat to the entire surface of the pipe. The lower part is perforated with apertures, and this part is in connexion with a steam-chest or boiler, and the connexion is closed by a tap or valve; so that when fire occurs this valve is opened, and the steam is admitted into the room, and the fire is thereby extinguished.

2750.—Francis Taylor, of Romsey, in the co. of Hants, for "*Improvements in apparatus for receiving, drying, and deodorizing human excrement.*" Patent dated Oct. 24, 1866.

This invention relates to two former patents, dated respectively April 9, 1861, No. 876, and Aug. 22, 1864, No. 2070. In performing the invention, under the pan of a privy-seat is placed a moveable inclined floor, which is moved when the lid of the seat is moved, so that the solid matter deposited upon it, after the liquid has been allowed to run off, is scraped off and made to fall on the revolving table below. Fastened to and under the moveable floor of the pan are two scrapers acting at the same time with the moveable floor, one in the centre not reaching closely down to the revolving table, the effect of which is to level and spread about the soft excrement, and mix it with any dry deodorizing powder, which is caused to fall with it, and push it to the outside of the table, and the other scraper at the side to catch and shovel off from the revolving platform the dried excrement, when, by the revolution of the platform, it comes opposite to this scraper. This revolution of the platform and the movement of the second scraper is obtained also by a crank fixed to the heel of the door. A box for containing ashes or powdered charcoal or soot is applied by the side of the pan, which throws into or sifts over (either voluntarily or involuntarily) the pan a small quantity of dry ashes or charcoal or soot to deodorize the excrement and the soiled sides of the pan.

2755.—Clinton Edgcumbe Brooman, of the firm of Robertson, Brooman, and Company, of 166, Fleet Street, in the City of London, patent agents, for "*Improvements in apparatus for lighting and heating.*" A communication. Provisional protection only obtained. Dated Oct. 26, 1866.

The object of this invention is to construct smoke-preventing apparatus for lighting and heating by gas or oils, and the invention mainly consists in the arrangement, as hereafter described, of the following parts:—viz., the feed tube for the gas or oil to be burnt, the draught or exit tube for the products of combustion and heated air which are utilized for heating, and special appliances either for the purpose of reflecting the light or for transmitting it and directing its effects as required.

The specification describes an arrangement of apparatus suitable for theatres, to be placed, say, before a box. It has externally the form of a lantern with six faces, terminated at the top by a hexagonal pyramid and at the bottom by a similar pyramid, but inverted; these parts form a lamp. On the upper pyramid a draught-pipe is connected for carrying off the hot air and products of combustion and leading them to places requiring to be heated. The products of combustion are thus drawn off from the lamp before they can issue into the room or building, where they would injure the decorations, paintings, and other contents. The middle portion or lantern is covered by a horizontal reflector, and contains the flame. Its sides are composed of prisms of crystal or other suitable material, which increase the brilliancy of the light and direct it round in perfectly clear and equal rays. When the apparatus is in the form of a globe the prisms will be replaced by parts of a globe. In the lower pyramid is the gasholder or box, which may be supported by a knob or button at the bottom of the apparatus. When oil is used instead of gas the lower pyramid contains the oil reservoir. The burner rises vertically from the lower pyramid to the lantern or central portion. The gas is conducted to the lamp by a tube running along the draught-pipe and lodged in a groove therein. It enters the lamp, and, after following the contour of the lamp, terminates in the gas-box. There is a curved reflector at one side of the burner, extending about half round it, for reflecting all the light into the body of the theatre. One face of each part of the lamp forms a door, and when open allows of lighting or of cleaning the lamp, and admits air to facilitate the combustion and increase the draught, and consequently the heat, especially in winter. In theatres and similar buildings the draught-tube which carries off the heated air and products of combustion is bent into a horizontal position, and may be concealed or disguised by ornamenting or otherwise. It terminates in a pipe, which is led round the "circle" or galleries of the theatre for warming the feet of the spectators. This pipe is enclosed in a box, through which fresh air may be made to circulate by fans or otherwise in summer for the purpose of neutralizing the heat.

In another arrangement of apparatus, the gas-tube is led down inside the draught-pipe, and there are two or more burners separated by reflectors, which reflect the light before and behind. The reflectors employed in these apparatus will vary in form according to the direction to be given to the light; they may be of glass or metal, and when of metal suitable spaces are left for the circulation of air. The prisms are cut with flat sides, and are placed vertically or horizontally, and fitted according to the quantity of warm air required. The arrangement before described will be varied according to the situations or places in which the apparatus are to be employed.

2756.—Henry Phillips, of Clyst Honiton, Exeter, in the co. of Devon, for "*Improvements in the preparation of deodorizing materials and in the manufacture of gas.*" Patent dated Oct. 25, 1866.

The chief object accomplished by the process herein described is the preparation of an efficacious deodorizing powder, which is effected in the following manner:—A quantity of slaked lime (hydrate of lime) in fine powder is added to coal tar in such proportion that, on being well mixed, the mixture shall be in a pulverulent state; about three parts by weight will require from one to two parts by weight of coal tar for this purpose. With such mixture a retort, such as is ordinarily used in gas-works for obtaining coal gas from coal, is charged; the tar at the temperature of the retort in good working order is rapidly decomposed, and the residuum in the retort consists of carbon minutely diffused through the powdered lime. A large quantity of gas of high illuminating power is also produced. When the production of gas ceases, the contents of the retort should be withdrawn, and sufficient water thrown on it to prevent the combustion of the carbon. The powder thus obtained is a deodorizing material, which may be used with advantage in dry closets, so designated in contradistinction to water-closets, and it may be used for deodorizing the contents of cesspits.

2759.—George Tomlinson Bousfield, of Loughborough Park Brixton, in the co. of Surrey, for "*Improvements in the manufacture of gases for the purpose of producing heat and the application thereof to metallurgical operations.*" A communication. Patent dated Oct. 25, 1866.

The improvements which constitute the subject matter of this paten may be divided into two principal divisions, the first relating to th production and method of burning the gases, and the second to th application of the gases to metallurgical operations, and each o these principal divisions is composed of parts or subdivisions.

It has long been known that a mixture of hydrogen and oxygen gases in the proportions in which they are combined in water (two volumes of the former to one of the latter) will, when burnt, produce an intense heat, but two obstacles have hitherto prevented the burning of this mixture for general purposes. The first of these obstacles has been the want of an economical method of producing the gases for use, and the second obstacle has arisen from the tendency of the mixture to explode when burned in a jet or otherwise.

The object of the first division of the invention is to obviate both of these obstacles. To this end the first part of the first division of the invention consists of the process of producing a mixture of hydrogen and oxygen gases by subjecting highly heated steam to the action of highly heated plantinum or its equivalent. In fact it is discovered that if plantinum and certain other metals be heated to a high temperature, say about 3300 Fahr., and steam previously heated, say to a temperature of about 2000 Fahr., be brought in contact with the heated plantinum or its equivalent, a decomposition of the steam into its elementary gaseous constituents, hydrogen and oxygen, takes place without apparent loss of either constituent or change of the plantinum, and the mixed gases may be collected and stored for use.

The second part of the first division of the invention consists of the process of burning the hydrogen and oxygen obtained as aforesaid, by mixing them previous to burning with another gaseous substance that renders the mixture inexplosive, and the gaseous substance which it is preferred to employ for the purpose, is the mixture of carbonic oxide and hydrogen obtained by decomposing highly heated steam by incandescent carbon. This part of the invention is based upon the discovery made by the present patentee, that when a gaseous mixture of hydrogen and oxygen (in the proportion in which they combine to form water) is mixed with an equal volume of the gaseous mixture of carbonic oxide and hydrogen produced by decomposing steam as aforesaid, the product may be burnt without danger of explosion, and the heat produced is of an intensity nearly as great, if not greater, than that produced by hydrogen and oxygen when brought together at the point where burning is effected.

2762.—Philip Albert Muntz, of Keresley, near Coventry, in the co. of Warwick, gentleman, for "*Improvements in the manufacture of metal tubes.*" Provisional protection only obtained. Dated Oct. 26, 1866.

According to this invention the manufacture of metal tubes is conducted in the following manner:—A short thick tube is first cast in the ordinary way, and is next rolled flat in the ordinary way. The flattened tube is afterwards passed through a pair of rolls having grooves semicircular in cross section, the said rolls being provided with a mandrel for opening the flattened tube. By passing the flattened tube through the rolls last described, it is directly converted into a cylindrical tube. Or the flattened tube may be partially opened by means of rolls having semielliptical grooves in them, the longer axis of the ellipse being in a plane perpendicular to the axis of the rolls. By these rolls the flat tube is opened without the for-

mation of fins. The elliptical tube is finally passed through the rolls having semicylindrical grooves, and thereby made into a cylindrical tube.

2788.—CHARLES M'BEATH, of Blackburn, in the co. of Linlithgow, N.B., carpenter, for "*Improvements in the treatment or distillation of shale, coal, and other bituminous substances, and in the means or apparatus employed therefor.*" Patent dated Oct. 29, 1866.

This invention consists essentially in the decomposition, treatment, or distillation of shale, coal, or other bituminous minerals or substances, for the purpose of obtaining or abstracting the gases, spirits, and crude oils (containing paraffin and other valuable matters) from the same, by the heat of its or their own combustion with the air in open-ended vessels or retorts, and allowing or directing the currents of rich inflammable and oily heated gases or products of such combustion to pass in it or up from the open end of the vessel or retort where the combustion is effected, directly up, through, and amongst the bituminous materials being so treated or decomposed.

2809.—MATTHEW PIERS WATT BOULTON, of Tew Park, Oxfordshire, Esq., for "*Improvements in apparatus for employing the motive power of jets of fluid.*" Provisional protection only obtained. Dated Oct. 30, 1866.

When it is desired to propel vessels moving through water, this invention in one form is applied as follows:—The ship or vessel to be propelled carries within it a vessel in which aëriform fluid is generated or contained under pressure, and a jet of this fluid issues from a nozzle or orifice communicating with this vessel. This jet issues into water supplied from the water outside the ship or vessel, and sets in motion a current of water moving in the same direction as the issuing jet. The current thus produced impinges on a curved surface, or flows through a curved channel by which it is deflected, so that it flows away into the water outside the vessel in a direction contrary to that in which it is desired to urge the vessel, or nearly in that direction. The pressure exerted by the current on the surface or body by which it is deflected propels the ship or vessel.

2827.—JAMES JOHN HOLDEN and SEALY JAMES BEST, both of Bermondsey, in the co. of Surrey, engineers, for "*Improvements in the doors or closures of gas-retorts.*" Patent dated Oct. 31, 1866.

These improvements consist in the application of parts to the closing of gas-retorts whereby two or more retorts may be closed by means of one door. To effect this object a chamber is applied to the retort mouth, which chamber establishes communication between two or more retorts. Each chamber has openings at back opposite to, and communicating with, the mouths of the retorts immediately behind it, which retorts thus communicate with the chamber through such openings. Each chamber has at front an opening occupying the whole, or nearly the whole, front of the chamber, and each such front opening is closed by a door, whereby the chamber is opened and closed, and as such door thus opens and closes the whole front of the chamber, it is clear that by opening the door access will be had simultaneously to all the retorts which open into such chamber. Hence, the charging and drawing of the retorts will be facilitated.

The specification describes two arrangements or modes of working and securing the doors of the chambers—viz., by sliding counterbalance weight doors and hinged doors, both closing with faced joints. Yet the patentees do not restrict themselves to such two arrangements or modes of working or securing them, though they believe them to be the best for the purpose, but other arrangements or modes of working and securing the doors, and even luted doors, may be used without departing from the nature of the invention as set forth.

2840.—THOMAS CHATWIN, of Birmingham, in the co. of Warwick, machinist, for "*Improvements in screw-stocks and tube-cutters.*" Provisional protection only obtained. Dated Nov. 2, 1866.

This invention as carried out in connexion with screw-stocks is performed as follows:—The screwing or cutting dies of the stock work in radial slots in the body of the stock, in the ordinary way. On the upper side of each of the said screwing or cutting dies is made a series of curved teeth or notches, the said teeth being struck from a common centre, or from the centre of the body of the stock, through which the rod to be screwed passes. Upon the top of the body of the screw-stock is placed an annular plate, capable of rotating freely upon the said stock. This plate may be kept in its place by means of a fixed shoulder on the body of the stock, under which shoulder the inner edge of the annular plate engages. Upon the under side of the said annular plate is made a spiral thread, the said thread being fitted to engage with the teeth before described on the upper side of the screwing dies. By a spiral thread is to be understood a thread the curves of which gradually recede from a point or centre, while they continue to revolve about the said point or centre. By rotating the said annular plate by means of a knob or projection upon it, the said spiral thread on its under side engaging with the teeth on the screwing dies gives a sliding motion simultaneously to the said screwing dies, and by rotating the annular plate in one or other direction, the said screwing dies may be advanced towards or separated from each other the required distance.

2841.—GEORGE WATSON, of the firm of Watson and Stewart, of Brisbane, in the colony of Queensland, and of Glasgow, in the co. of Lanark, N.B., plumber and gas-fitter, for "*Improvements in reflectors and ventilators in connexion with gas and other lights.* Provisional protection only obtained. Dated Nov. 2, 1866.

In one simple modification embodying these improvements there is a pendant gas-pipe, with a horizontal bottom pipe having a number of burners in it. At a little distance above the burners there is an oblong rectangular reflector framing carried by the gas-pipe, or by independent chains from the roof, or a bracket overhead. The sides of the reflector framing are inclined so that the bottom is the wider part, and the inner surfaces are formed for reflecting and throwing downwards and laterally the light reaching them from the burners. The reflecting surfaces may be formed in various ways, as, for example, of bright tin plate either plain or indented, and by preference protected by glass, or of silvered plain glass, or of silvered or unsilvered prismatic glass, or of platinized porcelain. The glass or part of it may in some cases be coloured.

2842.—STEPHEN HOLMAN, of 90, Cannon Street, London, E.C., in the co. of Middlesex, engineer, for "*Improvements in pumps and pump air-vessels.*" Provisional protection only obtained. Dated Nov. 2, 1866.

According to these improvements a continuous discharge of water or other fluids from pumps is obtained by means of a double piston or two detached pistons or buckets attached to one rod, and working in one cylinder and two detached valves placed in any convenient position in relation thereto, whereby uniformity of action and working strain is maintained, and the pump is produced at a comparatively little cost.

2847.—JOSIAH HARRIS, of 41, Threadneedle Street, in the City of London, for "*Improvements in apparatus for the production, distillation, and refining of hydrocarbon and other oils from shale, cannel, coal, peat, lignite, or other bituminous minerals.*" Patent dated Nov. 3, 1866.

In effecting the objects of this invention an ordinary exhausting fan or pump, to be driven or worked by steam or other motive power, is placed at the required velocity, at the delivery-pipe leading from the retorts used in the manufacture of such hydrocarbon oils, which fan or pump, being set in motion, creates a partial vacuum in the retorts and pipes, and thus draws off the vapours, fumes, smoke, or gases generated in the retorts during distillation. This invention is further employed to draw off in a like manner such vapours, fumes, smoke, or gases as are generated in the distillation of hydrocarbon oils; and in this part of the invention the said exhausting fan or pump is placed at the ordinary outlet of the condensing-worm leading from the still. This invention is likewise employed to draw off in a like manner from shale, cannel, coal, peat, lignite, or other bituminous minerals, such vapours, fumes, smoke, or gases as are generated in ovens or kilns for conversion into hydrocarbon oil.

2871.—JOHN RICHARDSON WIGHAM, of Albany House, Monkstown, in the co. of Dublin, Ireland, gas and lighthouse engineer, for "*Improvements in illuminating lighthouses, private residences, railway stations, mills, factories, and other buildings, and in apparatus and gas-burners employed for that purpose.*" Patent dated Nov. 6, 1866.

One part of this invention consists in illuminating lighthouses, private residences, railway stations, mills, factories, and other buildings, by means of a combustible gas of high illuminating power, prepared from alcohol and sulphuric acid, or from combinations of those subtances or of some of their ingredients with other known materials that are capable of being converted into combustible gases, which said gas is already known, but has never been applied to ordinary illuminating purposes.

For the purpose of preparing this compound gas an apparatus is employed, consisting of two closed receptacles of lead, earthenware, glass, plumbago, or other similar suitable substance, into one of which is introduced the alcohol and sulphuric acid, and through a pipe provided with a proper funnel or other convenient means of introducing the liquid, and heat is applied to the contents of the vessel either by means of a gas-flame or spirit lamp or by a jet of steam or boiling water or other heating agent whereof the said combustible gas is produced, which is then conducted from the first vessel through another pipe into the second vessel, in which is contained water or other liquid, which serves as a washer, purifier, hydraulic main, and condenser, and from which the gas is conveyed through a pipe to a gasholder for supplying the gas to the lamps or burners. Both vessels may be fitted with gauge pipes and cocks for maintaining the proper level of the liquids they contain, and for cleaning and washing out such liquids. The above described apparatus may be employed for producing the said compound combustible gas for illuminating purposes generally.

Another part of the invention has reference to an improved construction of gas-burner, termed "crocus burner," for which letters patent were granted to the present inventor, bearing date April 4, 1865, No. 945, and which consisted of a cluster of small gas-burners, surrounded below the level of the burners by a cylinder open at top and bottom, termed the "equalizer," through which a current of air, requisite for the combustion of the gas-flames passed, while immediately above the top of the flames was a second open cylinder, termed the "oxidizer," serving to raise to a high degree of heat the particles of carbon contained in the upper portion of the flames.

The present improvement consists in altering the construction of the crocus burner just described, by forming it of rings of gas-jets fitted to rings of tubes, or of tubes radiating from a centre, or partly of such rings and partly of curved tubes or radiating tubes in place of the curved tubes described in the specification to the above-named patent; also in placing and using such jets either vertically, horizontally, or obliquely, the flames from these jets so placed being burned either with or without the equalizer, but in all cases the overhanging oxidizer is used extended or diminished in size to suit the size of the burner; also in the extension laterally to any extent of the said jets of the crocus burner, so as to make the flame of any diameter required; and also in adding to the just described arrangement of burner a series of one or more rings of gas-jets and oxidizing cylinders, so arranged that the currents of air to the lower ring or rings of burners are greatly intensified by the action of the upper burners, and an effective combustion of the gas is carried on while the products of combustion from the lower burners are prevented mixing with the air passing to the upper burners by being made to pass immediately into the respective oxidizing cylinders. The above described improved arrangements of gas-burners are applicable as well to the illuminating of lighthouses, as also to all other purposes where

artificial light is required, and more especially where a strong light is required.

2873.—Nathaniel Fortescue Taylor, of 8, Manby Street, Stratford, in the co. of Essex, gas engineer, for "*Improvements in means for operating on air or aëriform fluids by hydrocarbons for purposes of illumination.*" Patent dated Nov. 6, 1866.

In carrying out these improvements the air or aëriform fluid to be acted upon is conducted through a chamber, where it is caused to absorb or become saturated with vapour from the liquid hydrocarbon carried or held in suspension by pieces of sponge or other suitable substance in motion, such motion being in a direction to meet the fluid to be acted upon, and the desired level of the liquid hydrocarbon in such chambers being regulated by floats contained in separate chambers.

2883.—Charles James Robinson, of 3, Old Church Yard, Liverpool, for "*Improvements in pump-valves, stop and let-off cocks or valves, especially adapted for hydraulic presses and high-water pressure.*" A communication. Provisional protection only obtained. Dated Nov. 6, 1866.

Valves constructed according to this invention are made by preference cylindrical, and of such a size as just to fit accurately into the passage or water way the valve is intended to close. When the valve is closing its passage or water way the stem rests upon a stop, and the valve is so supported, the stop acting as an abutment for the valve, and enabling it to resist the pressure of the water upon it; otherwise the valve would be carried through the passage, as it does not hang on a conical face like an ordinary valve. When the valve is resting on its stop, the valve-face or flat surface around the passage or water way is just flush with the surface of the valve, and the surface there rests on a piece of leather attached to the valve, and a perfectly tight joint is thus obtained.

2889.—William Edward Gedge, of the firm of John Gedge and Son, of 23, Southampton Buildings, Chancery Lane, in the co. of Middlesex, patent agent, for "*An improved combination of apparatus fitting within every sort of chimney, and preventing any smoke being driven back into apartments.*" A communication. Provisional protection only obtained. Dated Nov. 7, 1866.

In carrying out this invention two uprights are formed (rising from the hearth of the fireplace) with brickwork; these uprights are to be about 16 inches apart, and rising uniformly to a height of about 3 feet, and producing a depth of from 5 inches to 6 inches. These uprights will be built against and keyed in the thick back wall of the chimney, and occupy the whole width of the chimney, except the width left between them, and run up to the jambs of the said chimney. Starting from the above-mentioned height, the uprights are raised in the chimney, with the addition of the brickwork in front, so as to form in the body of the chimney a conduit-pipe. All the space of the original chimney is then filled in with brick, stone, or sheet-iron, starting from the height of the shelf. On one of the sides will, however, be left a small trap, which is raised at will, to allow of the sweeping. The opening above mentioned, having a height of some 3 feet, is intended to receive a sheet-iron apron, or flap, divided into three equal parts, and a small wrought-iron or brass framing is to be applied against the opening. The flap or apron is to be raised by means of a chain attached to a stud or ring on the lower part thereof, and another stud or stop is placed at the base of the framing. The chain will pass behind the apron and raise the framing by means of two pulleys fixed in the top of the framing, which it will raise, one part after the other, to create a draught. The framing will be maintained in position by a counter weight on the other end of the chain. The dimensions of all the parts named will be regulated by the size or capacity of the interior of the original chimney.

2908.—James Thomson, of New Wandsworth, in the co. of Surrey for "*Improvements in gas-stoves for heating and cooking.*" Patent dated Nov. 8, 1866.

This invention relates to means whereby more perfect combustion of the gas is effected. For this purpose, according to one arrangement, a stove is constructed which consists of two chambers connected together, but at a short distance apart, by hollow pillars or tubes, open at their ends to both chambers. The upper chamber is provided with a tube, open at both ends, and fixed in the centre of a plate forming the bottom of such chamber. In the centre of this tube a ring-burner is fixed. The hollow pillars or tubes are fitted with small tubes or wires in such manner as to divide or cut up the passage through such hollow pillars or tubes into small passages. To the centre of the bottom of the lower chamber is fixed a tube, open at both ends, and rising to within a short distance of the top of such chamber. The area of the tube, in the centre of which is fixed the ring-burner, should be such that a proper quantity of air may be admitted to effect a proper combustion of the gas, and it is found that for a burner consuming 2½ cubic feet of gas per hour a tube of 3 inches in diameter answers well. The upper or combustion chamber is provided with a moveable lid, which is luted into its seat, and the lower chamber is provided with a tap for running off the water produced by the combustions of the gas.

The action of the apparatus is as follows:—The gas being lighted at the ring-burner, the products of combustion pass up into the upper part of the upper chamber, and thence descend through the hollow pillars or tubes, where in their passage they are cooled or condensed, and fall into the lower chamber in the form of water; the nitrogen disengaged from the air passes out of the lower chamber through the pipe or tube fixed in the bottom thereof.

2909.—George Shaw, of Birmingham, in the co. of Warwick, patent agent, for "*Improvements in the manufacture of coke, and the small coke called breeze, and in the manufacture of coal gas.*" A communication. Provisional protection only obtained. Dated Nov. 8, 1866.

This invention consists in crushing or reducing to powder the coal from which the coke or breeze are to be manufactured, and mixing with the powdered coal lime or chalk, or other calcareous substance, which, on being heated, yields lime, and after exposing the coal so treated to the coking process or to decomposition in gas-retorts, quenching the coke while at a red heat with a large quantity of water, so as to remove from the coke the sulphide and phosphide of calcium formed by the combination of any sulphur or phosphorus in the coal with the calcium of lime. It also consists in the manufacture of coal gas free, or nearly free, from sulphur, by crushing or reducing to powder the coal from which the coal gas is to be manufactured, and mixing with the powdered coal lime or chalk, or other calcareous substance, which, on being heated, yields lime, and exposing the coal so treated to heat in the gas-retorts.

2915.—John Thomas Kershaw, of 90, St. Paul's Road, Islington, in the co. of Middlesex, surveyor, for "*An improved ventilator.*" Provisional protection only obtained. Nov 9, 1866.

The invention consists in the adoption of a back or valve falling into the chimney in such a manner as to throttle the said chimney, and so prevent it withdrawing from the lower part of the room, apartment, or shop to be ventilated, or from the lower part of the room, apartment, or shop below or adjoining, all the air it is capable of carrying off, and so compelling the chimney to withdraw the rest of the air it is capable of carrying off from the upper part of the room, apartment, or shop to be ventilated, which air is the hot or impure air to be got rid of.

2920.—Solomon William Woodroffe, of Costock, in the co. of Nottingham, farmer, for "*Improvements in the construction of privies, dust-holes, commodes, water-closets, ash-pits, and tank-covers, and for other similar purposes.*" Patent dated Nov. 9, 1866.

This invention consists in the employment of one or more discs, flaps, doors, or covers, hinged or otherwise, attached to the under side of a seat, flap, door, or cover, above which is placed another seat, flap, door, or cover. This last-mentioned seat, flap, door, or cover is capable of being depressed by hand or by the weight of the user or other weight, and it has projections on its under side which pass through slits or apertures in the lower seat, and press upon projections in the upper side of the first-named disc or discs, flaps, doors, or covers, which has or have weights or equivalent contrivances on its or their lower side, so that it or they shall effectually close or cover over an orifice or orifices at, to, or near which it or they is or are attached whenever there is no pressure upon the upper seat, flap, door, or cover. But when pressure is applied to the upper seat such hinged or otherwise attached discs will recede, slide, or fall away from beneath the orifice, leaving the whole space below such orifice open for the passage of any substance or liquid which it may be desirable to pass through the same, and on the seat being relieved of pressure the discs, flaps, doors, or covers will assume such position that they shall form an air-tight closure, and thus prevent escape of effluvia or noxious gas or vapour.

2926.—Henri Adrien Bonneville, of 38, Porchester Terrace, Bayswater, in the co. of Middlesex, patent agent, for "*An improved manure obtained by an improved process of purifying foul waters.*" A communication. Patent dated Nov. 10, 1866.

This invention relates to an improved process of using mineral substances, or such as are of vegetable origin, combined with lime, in order to obtain the purification of those waters which come from factories, households, closets, gutters, and sewers. The following materials are used:—First, the lignites in general (a production of vegetable origin) arising from the decomposition of plants which have not entirely undergone the coal transformation, friable or not, whatever may be the colour; secondly, an imitation of the lignites which may be obtained by means of pit coal, or the coke resulting from the carbonization of this pit coal, and finally, charcoal and all artificial coals, sulphate of iron, commonly called copperas; thirdly, clay commonly known as potter's clay, which is mixed with the substances indicated in the above-mentioned paragraph; fourthly, lime, which must always be used concurrently with one or other of the above-named substances, and after being slaked.

APPLICATIONS FOR LETTERS PATENT.

1978.—Thomas Calless Thomas, of Banbury, in the co. of Oxford, cutler and gas and water fitter, for "*Improvements in water-closet fittings.*" July 6, 1867.

1984.—William Archer, of Birmingham, in the co. of Warwick, coach builder, for "*Improvements in rotary engines and rotary pumps.*" July 6, 1867.

1987.—Nathan Thompson, of 15, Abbey Gardens, St. John's Wood, in the co. of Middlesex, for "*Improvements in unions or apparatus, for connecting together pipes or tubes, and for stopping the ends thereof.*" July 6, 1867.

1992.—Ivie Mackie M'George, of Commune Newry, Ireland, and Alfred Paul, of 33, Clevedon Street, Liverpool, for "*A new or improved plug-valve.*" July 8, 1867.

2000.—Matthew Piers Watt Boulton, of Tew Park, Oxfordshire, esquire, for "*Improvements in engines worked by the combustion of inflammable aëriform liquids and in apparatus for producing such fluids.*" July 8, 1867.

2004.—John James Buckley, of No. 1, Bond Street, in the parish of St. Luke, Chelsea, and Charles Hook, of Trinity Grove, Maidenstone Hill, Greenwich, in the co. of Kent, for "*The manufacture of a gas of superior illuminating and heating powers, together with the necessary appliances for the same being generated.*" July 9, 1867.

2022.—Frederick Holmes, of Plumstead, in the co. of Kent, engineer, for "*Improvements in pumps.*" July 10, 1867.

2045.—Frederick Wilkins, of 20, York Buildings, Adelphi, in the co. of Middlesex, civil engineer, for "*Improvements in apparatus for producing or increasing the light or heat from carbonized atmospheric air, gas, or gaseous mixtures by the use of hydrocarbons, oils, spirits, or other inflammable liquids, or any mixture thereof.*" July 12, 1867.

GRANTS OF PROVISIONAL PROTECTION.

1791.—Ebenezer William Hughes, of 5, Queen Square, Westminster, and Thomas Howard Head, of 9, Dowgate Hill, in the City of London, for "*Improvements in rotary engines and pumps.*" June 19, 1867.

1819.—George Dickie, of Kilwinning, in the co. of Ayr, N.B., for "*Improvements in the manufacture of illuminating gas.*" June 21, 1867.

1820.—George Simpson, of Whitburn, in the co. of Linlithgow, N.B., for "*Improvements in charging and emptying retorts, and in the machinery or apparatus employed therefor.*" June 21, 1867.

1821.—Francis Reddicliffe, of Seglenlas Mine, Llanidloes, in the co. of Montgomery, mine agent, for "*Improvements in buckets for pumps, especially suitable for pumps for mines, and in pistons for steam and other engines.*" June 21, 1867.

1822.—Emery M'Clintock, of the Langham Hotel, in the co. of Middlesex, gentleman, for "*Improvements in the construction of motive-power engines and pumps.*" June 21, 1867.

1827.—Stephen Holman, of 10, Laurence Pountney Lane, London, in the co. of Middlesex, engineer, for "*Improvements in double-action pumps, and in the methods of operating pumps, part of which improvements are applicable to other reciprocating machines.*" June 22, 1867.

1828.—Thomas Wilson and William Hall, both of the town and co. of the town of Newcastle-upon-Tyne, engineers, for "*Improvements in machinery or apparatus for raising and forcing water and other fluids.*" June 22, 1867.

1834.—Thomas Rafferty, of Manchester, in the co. of Lancaster, gas engineer, and John Henry Storey, of the same place, brassfounder, for "*An improved apparatus to be employed in moving from place to place, laying down, and jointing metal pipes.*" June 24, 1867.

1837.—Elliott Perry Gleason, of the city and co. of New York, U.S.A., gentleman, for "*Improvements in cylindrical or Argand gas-burners.*" June 24, 1867.

1846.—Thomas Crow, of West Ham, in the co. of Essex, tar distiller, for "*Improvements in the manufacture of illuminating gas from gas-tar oil or from gas tar.*" June 25, 1867.

1849.—Adam Aitchison, of 6, Park Terrace, Peckham, in the co. of Surrey, and Thomas South, of Bridge Street, Southwark, in the said co., gas engineers, for "*Improvements in means or apparatus for the production of gas for illuminating and other uses from hydrocarbons, which apparatus is also adapted to be used for culinary and other heating purposes.*" June 25, 1867.

1931.—John Somerville, of the Gas-Works, Maidstone, and Robert Elsdon, of Maidstone, in the co. of Kent, engineer, for "*Improvements in the treatment of apparatus employed in the manufacture and materials used in the purification of gas.*" July 3, 1867.

1978.—Thomas Caless Thomas, of Banbury, in the co. of Oxford, cutler and gas and water fitter, for "*Improvements in water-closet fittings.*" July 6, 1867.

1984.—William Archer, of Birmingham, in the co. of Warwick, coach builder, for "*Improvements in rotary engines and rotary pumps.*" July 6, 1867.

1987.—Nathan Thompson, of 15, Abbey Gardens, St. John's Wood, in the co. of Middlesex, for "*Improvements in unions or apparatus for connecting together pipes or tubes, and for stopping ths ends thereof.*" July 6, 1867.

INVENTION PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

1967.—William Robert Lake, of 8, Southampton Buildings, Chancery Lane, in the co. of Middlesex, consulting engineer, for "*Improvements in the manufacture of illuminating gas, and in apparatus employed in the said manufacture.*" A communication. July 4, 1867.

NOTICES TO PROCEED.

608.—Henri Ulliel, of the Avenue de Neuilly, in the department of the Seine, France, manufacturer of gas apparatus, for "*Improved apparatus for the production or improvement of inflammable gases.*" March 5, 1867.

621.—John Garrett Tongue, of the firm of Tongue and Birkbeck, patent agents and engineers, of 34, Southampton Buildings, Chancery Lane, in the co. of Middlesex, for "*Improvements in steam-engines and pumps.*" A communication. March 6, 1867.

631.—Charles William Siemens, of 3, Great George Street, Westminster, in the co. of Middlesex, for "*Improvements in apparatus for measuring water, alcohol, and other fluids.*" March 7, 1867.

641.—Paul Rapsey Hodge, of 106, Cannon Street, in the City of London, civil engineer, for "*Improvements in hydraulic motors.*" March 7, 1867.

690.—Joseph Pearson, of Birmingham, in the co. of Warwick, brass-finisher, for "*Improvements in ball or supply valves.*" March 11, 1867.

696.—Matthew Piers Watt Boulton, of Tew Park, Oxfordshire, esquire, for "*Improvements in propulsion, and in rotary apparatus for giving motion or energy to fluids, and receiving motion or energy from them.*" March 11, 1867.

708.—John Fox, of 3, Navarino Grove, West Hackney, engineer, for "*Improvements in filters.*" March 13, 1867.

915.—Matthew Piers Watt Boulton, of Tew Park, Oxfordshire, esquire, for "*Improvements in apparatus for receiving motion or energy from fluids and for imparting it to them, in the propulsion of vessels, and apparatus to be used for that purpose.*" March 28, 1867.

1407.—William Robert Lake, of 8, Southampton Buildings, Chancery Lane, in the co. of Middlesex, consulting engineer, for "*An improved mode of constructing metal cocks, faucets, and other similar articles.*" A communication. May 11, 1867.

1684.—James Warburton, of Hythe, in the co. of Kent, for "*Improvements in apparatus for registering and recording the quality of gas.*" A communication. June 7, 1867.

PATENTS WHICH HAVE BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £50 BEFORE THE EXPIRATION OF THE THIRD YEAR.

1499.—George Newton and Joseph Braddock, "*An improved compensating gas-meter.*" June 16, 1864.

1545.—James Forbes, "*Improvements in the means of and apparatus for manufacturing sulphate of ammonia and sulphuric acid.*" June 21, 1864.

1548.—John Henry Johnson, "*Improvements in raising water, and in the machinery or apparatus employed therein.*" June 21, 1864.

1561.—John Jones, "*Improvements in dry gas-meters, parts of which are applicable to apparatus for regulating the flow of air.*" June 22, 1864.

1602.—Charles Denis, "*Improvements in gas heating or cooking stoves.*" June 25, 1864.

1627.—Manuel Leopold Jonas Lavater and Edward William Niblett, "*Improvements in water-closets and urinals.*" June 29, 1864.

1637.—Daniel Gallafent, "*Improvements in pumps.*" June 30, 1864.

1638.—Frederick Ludewig Hahn Danchell, "*Certain improvements in apparatus by means of which air, gas, or vapour is to be removed from tubes, pipes, tunnels, pans, retorts, or other vessels.*" July 1, 1864.

1651.—George Frederick Graham and William Payne, "*Improvements in the manufacture of high-pressure cocks.*" July 2, 1864.

1658.—William Jackson, Thomas Glaholm, and Samuel Sinclair Robson, "*Improvements in pumps.*" July 2, 1864.

1668.—William Lloyd, "*Improvements in the manufacture of hydrocarbon gas, and in apparatus employed therein.*" July 5, 1864.

1868.—William Edward Newton, "*An improved process for cleansing or clarifying impure water.*" July 7, 1864.

1718.—Alfred Vincent Newton, "*An improved apparatus for measuring the flow of liquids.*" July 11, 1864.

1747.—Gurdon Wadsworth Pitcher, "*An improved self-adjusting pipe-wrench.*" July 13, 1864.

PATENTS WHICH HAVE BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £100 BEFORE THE EXPIRATION OF THE SEVENTH YEAR.

1532.—Henry Jones, "*Improvements in water-closets.*" June 23, 1860.

1640.—John Leslie, "*Improvements in the manufacture of gas.*" July 7, 1860.

Parliamentary Intelligence.

HOUSE OF LORDS.

Monday, July 8.

The Kirkcaldy and Dysart Water Bill was read a third time, and passed.

The East London Water (Thames Supply), and the East London Water (Various Powers) Bills, were read a third time, with the amendments, and passed, and sent to the Commons.

Tuesday, July 9.

The Leeds Corporation Water Bill was returned from the Commons, with the amendments agreed to.

Friday, July 12.

The East London Water (Thames Supply), and the East London Water (Various Powers) Bills, were returned from the Commons, with the amendments agreed to.

Monday, July 15.

The following Bills have received the Royal Assent:—

The Southport Water; Herne Bay Water; Peterborough Water; Lampeter, Llandyssil, &c., Gas; Crickhowell Gas and Water; Widnes Gas, Water, and Improvement; Enfield Gas; Plymouth Corporation Water; Wallasey Improvement; Wolverhampton New Water; Kirkcaldy and Dysart Water; Leeds Corporation Water; East London Water (Thames Supply), and the East London Water (Various Powers) Bills.

Tuesday, July 16.

The Tynemouth Parish Gas Bill was returned from the Commons, with the amendments agreed to.

HOUSE OF COMMONS.

Monday, July 8.

The Leeds Corporation Water Bill.—The Lords amendments were agreed to.

Friday, July 12.

The East London Water (Thames Supply), and the East London Water (Various Powers) Bill.—The Lords amendments were agreed to.

The Metropolis Gas Bill.—The petition of the Tunbridge Wells Gas Company against the Bill was referred to the Select Committee on the Bill.

The Metropolis Subways Bill was reported, as amended.

Monday, July 15.

The Tynemouth Parish Gas Bill.—The Lords amendments were agreed to.

Friday, July 19.

The Risca and Pontymister Gas Bill, as amended, was considered.

HOUSE OF COMMONS.

TENTH DAY—MONDAY, JUNE 17.

The sitting this day was occupied in hearing the opening speech of Mr. Hope Scott, in the case of the Chartered Gas Company's bill, at the close of which the chairman stated that the committee considered it desirable to complete the general case before proceeding further with this inquiry.

ELEVENTH DAY—TUESDAY, JUNE 18.

METROPOLIS GAS ACT AMENDMENT BILL, 186".

The committee were partly occupied in hearing the opening speech of Mr. Denison, in the case of the Imperial Gas Company's bill, at the close of which the general inquiry was resumed.

The CHAIRMAN reminded the parties that before the holidays it had been arranged, when the committee separated, that such facts as, being really statistical in character and scarcely matters of controversy, could be presented to the committee in a tabular form instead of *viva voce*, should be so presented, the parties on both sides agreeing upon the facts to be tabulated.

Mr. HOPE SCOTT stated that the unexpectedly early termination of the first stages of the two private bills had taken his clients a little by surprise, but that the intimation of the committee should be attended to.

The CHAIRMAN said the committee were often hearing details from witnesses about the capitals of the companies or the price of coal and cannel, which could not be matters of serious dispute, but they occupied time and cost the parties a good deal of money, and of course tended to increase the difficulty with regard to the passing of the bill. On a previous day the learned counsel was engaged for an hour and twenty minutes in examining one witness, and the committee felt that when it was done they had learnt nothing, at all adequate to the consumption of time, which they did not know before.

Charles Edward Cawley, Esq., examined by Mr. HOPE SCOTT.

I am a civil engineer, and am alderman of the borough of Salford. The gas-works there belong to the corporation, and are managed by a committee of that body, of which I am the chairman. I have been a member of that committee ever since 1853, and have been chairman or deputy-chairman most of the time. The Manchester and Salford Corporations, up to a recent period, only used Wigan cannel in the manufacture of gas. The Manchester Corporation now use 33 per cent. of coal.

Mr. HOPE SCOTT: Has your experience at Salford enabled you to give an opinion as to what can be produced from that proportion of cannel and coal in the way of illuminating power?

Witness: We have never used anything near so much coal as that. Our year terminates in June, and I have not got the return for last year; the previous year we only used about 5 per cent., but I know that we cannot get anything like the quality of gas that has been spoken of here. They do not get that quality of gas from the Wigan cannel on an average. Our average is stated at 20 or a little over—21 candles, as tested by Dr. Angus Smith at the works, but it is only an occasional testing; generally once a week, and sometimes not more than twice a month. I know very well from experience that frequently the illuminating power is below that, and if the gas were to be tested with the care that it is tested with where you are under penalty from hour to hour, it would not be anything like 21-candle gas. I am now speaking of the gas tested at the works; and of course the illuminating power is higher by perhaps a couple of candles than it would be at a considerable distance off. My experience shows me that it is impossible to produce 18 or 19 candle gas at 1000 yards from the works, or more than that, without using all cannel or else limiting the production, because you cannot get above a certain quantity of gas of a higher illuminating quality from the cannel. Some small portion of the cannel is better than others; but, independently of that, the earlier gas that comes off is the highest in quality. If you obtained the quantity, you certainly would not obtain that quality of gas without a larger portion of cannel. From the neighbourhood of Salford to Manchester there is a certain amount of rivalry, which has led me to look particularly to their gas and their accounts. I burn both gases, one in my house and the other in my office; and, since they have used so much coal, there is no question that the Manchester gas has been of a less illuminating power. It is quite a mistake to say that there has not been any complaint. There have been many complaints in the newspapers during the last winter. I have examined the Manchester accounts very carefully; I have them here. I know the deductions that are made, especially by Mr. Cleminshaw, from them. I find the following errors in his statement:—There is one important amount affecting the accounts of both Manchester and Salford, when compared with the companies here—that is to say, that in both those cases the maintenance of the works under the head of "Depreciation" is charged separately to a depreciation-fund. It is debited to revenue, but under this head of "Depreciation" in the corporation accounts there is no such item; and in Manchester it amounted to just over 3d. per 1000 cubic feet of gas sold. In Salford it is the same, but we deal with it differently. In the Manchester accounts they charge the whole of their expenditure for extensions and renewals to one account, and deduct from that the amount which they charge for depreciation, which is debited to revenue, and which in the year 1866 was £13,817 (that Mr. Cleminshaw did not include); whereas in the London companies returns it is included.

Mr. PEEL: In the cost of manufacture they charge depreciation?

Witness: Yes; they charge the maintenance of their works as part of the cost of manufacture.

Mr. PEEL: That accounts for the 3d. per 1000 cubic feet difference?

Witness: Yes. It may happen, and I believe it does, that, in taking the London accounts, you will find in some years it is more and in some years it is less. To avoid that we have a depreciation-fund.

The CHAIRMAN: What you say is, that Mr. Cleminshaw represented Manchester as unduly favoured in comparison with London, by reason of having omitted to take in a charge for depreciation which you consider equivalent to about 3d. per 1000 cubic feet?

Witness: Yes; that is the actual sum charged.

Examination by Mr. HOPE SCOTT continued: I think Mr. Cleminshaw put the illuminating power of the gas at Manchester at 22 to 23 candles; the cost of coals at 10·116d. per 1000 feet—that is, without leakage; and wages, including leakage, at 11·950d. With regard to the actual quantity, I do not know where he got his figures from, because they do not return the quantity of gas made. They gave us the money, and the town-clerk gave us the price; that, of course, is easily worked out, but it is in that way I had it. The leakage at Salford is now 12 per cent., but it was considerably more some few years ago. My own impression is that the difference is due chiefly to the improvement in the meters, because there is no greater fallacy, in my opinion, than to look upon it as leakage; it is unaccounted-for gas. How much of it is leakage we have no means of knowing, but I do not believe it is anything like the largest proportion. The way in which both Mr. Cleminshaw and myself can in any way ascertain the proportion of the charge due to loss of gas is by making a calculation from the money and the prices given, and it is, according to my calculation from these figures, 11 per cent. in Manchester. Mr. Cleminshaw makes out that a charge of 3s. per 1000 feet will leave 13·934d. as the amount of profit on capital. That charge covers the cost of wages, unaccounted-for gas, and the profit. The profits charged in Manchester are on a smaller capital than has been actually expended in the works by a considerable amount.

Mr. HOPE SCOTT: Now, contrasting the case of Manchester with that of the London companies, he puts the coal per 1000 feet at 9·358d.; wages and leakage, 24·356d.; profit and charge on capital, 14·286d.; making up altogether 4s., according to their present way of working?

Witness: Yes; I think you may deduct 12d. from the 24d. as the difference between the 4s. and the 3s. It is not that the London companies come up to that, but that if 4s. was requisite it would take that under these heads. His view is that the difference of 1s. in the cost is the difference that arises from what he calls leakage, and in the labour and expense connected with that leakage.

Mr. HOPE SCOTT: Do you know what is the average amount of unaccounted-for gas in all the London companies?

Witness: I can work it out. It is about 15 per cent., I think, actually from their returns; it is about 15 or 16 per cent., but it will vary from year to year.

Mr. HOPE SCOTT: Do you find that in Manchester all the charges for labour which are incident to the working of the London companies are brought in against the gas-works and in the gas accounts—for instance, lighting the lamps?

Witness: With the London companies some of the accounts include them and some do not. In neither Salford nor Manchester is the lighting of the lamps or the repair of the lamps at all included. They are done by the corporation, but in different departments, and they do not appear in the gas accounts at all.

Mr. HOPE SCOTT: Nor does the reinstatement of the streets form a charge.

Witness: Yes; but I think there would be very little of that except in extensions, and then it goes to capital. In London, of course, if the companies have to take up the streets the expense is very heavy.

Mr. HOPE SCOTT: Working out those differences which we establish between your view of the Manchester case and the London case and that of Mr. Cleminshaw, now would you alter his figures?

Witness: The net cost of the materials for 1000 feet sold in Manchester is 11·36d. after deducting the residual products. With regard to the eight companies in London who make common gas only (the other four it is impossible to compare), their net cost is 13·09d. The general charges in Manchester, charged to the account, are 12·20d. on the gas sold; those in London including the meters (of which Manchester has very few) are 18·32d. The depreciation in Manchester is 3·02d., so that the real difference between the charges in Manchester and London is just 3·1d. for the general charges and cost of the works; and that is fully accounted for by the different circumstances of the two places, I think. The difference is 3·1d.—*i. e.*, the actual cost of last year of those eight companies in the metropolis for coal, material, and labour was 31·41d. as against 26·58d., excluding profit and charges on capital. The amount of capital actually invested in Manchester per ton of coals carbonized is somewhere about £7—a little more than £7. It is over £800,000 of real capital, and the number of tons carbonized, according to the prices, works out to 118,533. The money figure which represents a 10 per cent. dividend in the price of gas, upon the aggregate London capitals is, for the eight companies which make common gas only, 16·09d., and for the four companies which make common and cannel gas, 16·92d., upon their sales of last year. The Western Company, which makes only cannel gas, is more—it is 22·84d. A difference of 6d. in the price of gas would be a most material difference; it would be all taken from the dividend practically.

Mr. GOLDNEY: You have no sources of information except the accounts of the companies, I suppose?

Witness: I believe you have not materials for making a calculation. Mr. Cleminshaw has given you one figure, and I have given you another. The committee have got the dividends—that is to say, the capitals—in the returns, but you have not got there the quantity of coal carbonized, and the quantity of gas made and sold. Those former returns are inferences and calculations made by Mr. Hughes, but the returns given by the companies themselves do not contain them.

The CHAIRMAN: Do we understand you to say that you have a personal knowledge of the quantities of coal carbonized, and the quantities of gas made and sold in London, which we have not had before us from any other source?

Witness: I have the figures furnished to me by the companies, and those figures you have not before you, as far as I know. I am speaking of the London companies.

The CHAIRMAN: That is to say, we are occupied in learning from the companies, through the chairman of the Gas Committee at Salford, that of which he knows nothing, and of which they know everything.

Mr. HOPE SCOTT: The witness is a civil engineer, and being acquainted with gas matters at Salford, speaks of the comparison between Manchester and London. He has looked into that question generally, and it is in the nature of a general witness that he is now speaking on this point. Here is a table which he will put before the committee.

The CHAIRMAN: This seems to me to be exactly one of those papers that we thought might be compared between the parties and probably agreed upon.

Mr. PEEL: If the witness could give us the actual capital which the Salford works are now using, and the amount of coal that they carbonize annually, the cost of it, and the amount that they spend in labour per 1000 feet, that evidence would be valuable as a basis for any calculation we might wish to make.

Mr. HOPE SCOTT: He has done that with regard to Manchester. (To the witness:) Will you now give the committee the same particulars with regard to Salford?

Witness: As to the capital invested in these works at present, the depreciation-fund is not deducted from it; we keep the works up, and there is a fund lying by in the bank out of which the renewals are all made.

Mr. PEEL: Which is, in fact, so much depreciation.

Examination continued: The prime cost is charged to capital, and the depreciation to revenue. The amount of capital invested in the works was £161,000 twelve months ago, £10,000 or £12,000 having been written off the original expenditure for depreciation long before. In addition to that, there would be the capitalizing of the chief rent of the works at Langley; they are on a chief rent of £284 a year, which is worth about 24 years purchase now, because it is improved land. The original expenditure upon the works was larger than the £161,000 by £10,000 or £12,000.

The CHAIRMAN: The original expenditure was only larger because depreciation, which ought to have gone from revenue, had at one time been charged to capital to the extent of £12,000?

Witness: Yes.

The CHAIRMAN: And you think it proper to strike that off?

Witness: Yes.

Examination continued: The ground rent should be capitalized in the calculation, because the works ought to have been bought. We are now obliged to buy more land, and have a bill, which has passed this session, for that purpose. Our manager, Mr. Hall, gave the details of the cost of production, and I confirm his evidence. I saw his figures before he gave them, and he gave them correctly.

Cross-examined by Mr. RODWELL: I think, as a commercial matter, people would not like a less profit than 10 per cent. upon the manufacture of gas. I consider that would be a fair return. I have not had the curiosity to work out the amount of profit at which the gas made at Salford is sold. When I say 10 per cent. is a fair return, I do not mean 10 per cent. on the gas made; that is not 10 per cent. profit, but 10 per cent. upon the capital.

Mr. RODWELL: Suppose you have £100 worth of gas—*i. e.*, gas that has cost £100 to produce—what would you sell it at for a fair profit?

Witness: That involves a question that does not admit of a general answer, because it would depend upon what is included in "cost." Some people would include in the cost of production capital, and interest on capital.

Mr. RODWELL: Take it in any way you please.

Witness: My answer is, that I think the parliamentary dividends are not in excess.

Mr. RODWELL: That is not an answer to my question. Choose what capital you like (you know what capital would be necessary to produce £100 worth of gas), and give me an answer. Tell me what you think would be a fair profit.

Witness: A fair return upon the capital invested and employed? I say that 10 per cent. is not, in my judgment, in excess, but I cannot reduce that in the way you put it.

The CHAIRMAN: I am just in the same position as the witness. I cannot understand what £100 worth of gas means, except gas that would sell at £100; but if you mean gas that would cost £100 in making, then you have to go through a very elaborate calculation of how much is to be allowed for plant and other things.

Mr. RODWELL: The question was suggested by the table. I say, what is the cost of £100 worth of gas to produce it wholesale, and to be retailed as any commercial commodity—what would you consider, as a commercial man, a fair profit?

The CHAIRMAN: The witness says 10 per cent. on the capital invested in the business.

Mr. RODWELL: I observe by the table put in here that the average profit there is about 50 per cent.

Witness: No; it is less than 10 per cent., because the dividend and interest calculated is the actual amount taken from the company's payments, part of which is less than 10 per cent.; therefore the average must be below that. What it works out per 1000 feet is a totally different question.

Cross-examination continued: The difference between the price charged and the net cost is over 50 per cent., but that tells us nothing with regard to the rate of return in the name of interest or profit. The sums paid for interest and dividend depend on the capital of the company. Unless it can be proved that the actual capital is in excess, it must be taken to be that which is necessary for the production of the gas. I do not admit, in a general way, without defining what is meant by the cost of gas, that everything that does not go to that is in excess. We use Wigan cannel at Salford the same as that which is used in Manchester. In fact, it comes from the same people. They have been driven to use more coal during the last two years than we have, though we have had to use some.

Mr. RODWELL: Can you account for the difference between Mr. Cleminshaw and yourself?

Witness: I think Mr. Cleminshaw has no practical experience of what Manchester is now, and I have had that experience for many years past. I know this as a matter of observation. I told them before these gentlemen went down to test it that they would find the Manchester gas inferior to the Salford gas; I know it from observation. At times, no doubt, they have had better gas. I have not tested the Manchester gas. I have no knowledge of it, except from observation, and from comparing it as used in my office with that which I use in my house.

Mr. PEEL: I understand you to say that the gas which you make in Salford is not 21-candle gas, but probably 18-candle gas.

Witness: If it were tested hour by hour at 1000 yards from the works, I think the average would not be more than 18 or 19 candles. In the year 1866 we only used 5 per cent. of coal; perhaps a little more last winter.

The CHAIRMAN: You have no proof, probably, of how many candles power you can obtain from Newcastle coal?

Witness: Not from my own experience.

The CHAIRMAN: You cannot give us any opinion as to how much per candle it would cost to raise the illuminating power from 14 to 18 candles?

Witness: It depends upon the cost of the cannel. In London, so far as I can make out, it would be 2½d. or 3d. per candle—certainly not less. I know this, and probably you know it, that Wigan cannel is practically a monopoly.

The CHAIRMAN: You have no experience of what mere coal will yield, your experience being rather of what mere cannel will yield?

Witness: Yes. I only know from other works where I have been called in.

Re-examined by Mr. HOPE SCOTT: Out of £100 received for gas sold, my figures would give 33 per cent. as due to profit and interest; that is to say, on the capitals actually employed by the companies. I ought to say that we have varied 1d. or 2d. in our receipts for the residual products. We have been getting for two or three years exorbitant prices for the residual products, owing to the new dye, which, not proving first, has gone out of fashion, and the consequence is that the residual products have dropped down about one-half.

Mr. DAVISON stated, on the part of the Board of Trade, that matters having taken an unexpected turn with regard to Dr. Letheby not having been called, and the question of burners having been raised, he should ask the leave of the committee to call one or two witnesses of experience to speak upon that point at the end of the case, or at any other time that the committee pleased.

The CHAIRMAN said the committee had always postponed evidence which was stated by the learned counsel to point to the schedule until the schedule was itself distinctly before the committee, but they gave no decision as to whether, if the learned counsel thought it important as to the main case, they also should think so.

Mr. HOPE SCOTT said that his learned friend agreed with him that it was important to know whether there was any difference with regard to the burners. Dr. Letheby, in his evidence last year, laid great stress on the difference between the old and new burners in the City of London only. The witnesses for the companies had said that the burners were the same, differing only in durability of aperture on account of the steatite.

Mr. MICHAEL said he was stopped in the examination of the witnesses with regard to the burners, the chairman having stated that he would take that as a separate matter.

The CHAIRMAN said whenever the question of burner had been gone into he had asked the learned counsel whether it was with a view to the schedule, and having been always told that it was, he had said that the committee wished to keep the evidence relating to the schedule until the time when it should be before them; but they had never stopped anybody in giving evidence that was at all material to the main issue.

Mr. MICHAEL said his evidence was with regard to the schedule.

Mr. GROVE said it seemed to him that this was a most important inquiry for the committee on the main question, assuming that it could be shown to them that by known or probable improvements in the burner the amount of gas which now produced 12 candles could produce 16 candles illuminating power.

The CHAIRMAN said the committee had not had the advantage of hearing any statement from Mr. Grove; therefore he had been obliged to ask the learned counsel, when they produced their witnesses, whether the evidence pointed to the schedule, and he had always said that the committee would postpone such evidence until the schedule was before them. But if the Metropolitan Board, in the general conduct of their case, had produced evidence which related to the burners, and that evidence had appeared to the committee relevant, they would have taken it.

Mr. GROVE said he understood the junior counsel for the Board of Trade to say at the close of the case that evidence would be tendered on that point on the part of the board.

The CHAIRMAN said Mr. Sugg was asked the question whether the burner which it appeared went by his name was the same burner that was used when the Act of 1860 was passed, and whether his improvements consisted in putting in a material that was durable, in lieu of one that wore out? His reply was—"Yes, exactly so; that was the improvement, and the only one."

Mr. GROVE said that that was not what they were instructed; they considered that the burner actually gave more light.

The CHAIRMAN said there must be some rule about the conduct of the inquiry. Mr. Grove had closed his case, and the committee had called Mr. Sugg, and had asked him the question and obtained his answer.

Mr. GROVE said he had not gone into the question of the burner, because the learned counsel for the Board of Trade had stated that he should tender evidence udon that subject, and that he (Mr. Grove) then thought it better to wait until he had done so.

Mr. O'MALLEY said the question before the committee would afterwards determine itself into this: whether the burner proposed in the schedule was a fit burner to be adopted, and that would depend upon the illuminating power which the committee chose to concede. Every one knew that a burner which was perfectly effective for testing a lower quality of gas was not an effective burner for testing a higher quality. It would be therefore necessary to specify the description of burner.

The CHAIRMAN said this was a public case, as well as a case between the parties, and the committee wanted to get at the truth. According to the mode in which the case had been conducted, the City and the Board of Works had been consolidated into one party, but now he understood that those who appeared on the part of the Board of Works dissented from the way in which the City had conducted their case.

Mr. GROVE said he had heard it stated, on the part of the Board of Trade, that they were going to tender evidence with regard to the burner; that was his understanding, and all that he was anxious to impress upon the committee was this, that supposing subsequently, on the question of the schedule, the committee were to be convinced, the question of the burner would then become an important element in the question of price, because, by altering the form of the burner the gas companies could by a given amount of gas consumed, produce 16-candle gas instead of 12-candle gas; therefore it became a very important question.

The CHAIRMAN remarked that the evidence before the committee at present was to the effect that the burner of 1867 gave the same standard as the burner of 1866, and therefore it did not appear to him that they would be making any mistake by deferring until they came to the schedule their decision upon the question of the burner. They would assume, until they came to the schedule, that they were dealing with the burner spoken of in the Act of 1860.

Mr. DAVISON said their only desire was to give evidence upon the matter, as they found there was a conflict between the printed evidence of last year and the *viva voce* evidence of this year. They had had experience now, and he believed one of his learned friends told the committee that they would tender evidence upon the subject. It might be tendered then if the committee considered it a convenient moment for so doing. It appeared to be of some importance for this reason, that if the committee defined an illuminating power of 16 or 18 candles, or any other number of candles, they could not know what that power would actually be until they settled the burner in the schedule.

The CHAIRMAN asked what mistake the committee would be liable to make, or what injury they were likely to do, if they went through their proceedings assuming that when they spoke of 14 candles they meant the 14 candles as defined in the Act of 1860; and if when they came to the schedule they should deal with the burner, they could continue to be dealing with the same thing from beginning to end.

Mr. DAVISON and Mr. O'MALLEY assented to this arrangement, and said it would meet their views.

Mr. MICHAEL handed in a statement of the illuminating powers prescribed by Parliament from 1856 to 1866, with date of Act and maximum price; an analysis of the House of Commons return of August, 1866; a table giving the capitals of several provincial gas companies; and a table giving the capital and various financial details of the Western Company, in connexion with the Metropolitan Gas Bill of 1867.

The CHAIRMAN stated that he wished it to be understood that although the examination of witnesses upon certain points had been stopped, yet Mr. Hope Scott was not to be precluded, in making his speech, from referring to them, on the ground that they had not been given in evidence.

TWELFTH DAY—WEDNESDAY, JUNE 19.

Robert Baxter, Esq., examined by Mr. DENISON.

The tables I hand in have been prepared according to the instructions given by the chairman yesterday, and also before the holidays. They have been communicated to our opponents, and, as far as my opinion goes, they comprise all the things which are capable of being reduced to unquestionable figures, and are not subject to any dispute. I have got from the various companies returns on all those facts, and those returns are accurately embodied in this paper, I believe. I was agent for the gas companies in the contest of 1860, and for some time anterior to that. The companies had established districts before the bill of that year was brought in, and it was to legalize the districting that the bill was proposed. The districting was offered by the public, as represented by the vestries, as a boon to the gas companies. It was a boon to them to this extent, that, after the passing of the Act, none of the companies could, without the authority of Par-

liament, compete with the others. That was the answer given to the companies whenever they complained of the bill as being brought in against them, at a time when they were not asking any favour from Parliament. It was said—"By bringing in the bill we propose restrictions as to the price and illuminating power, but you must remember that we are legalizing the districting, and so delivering you from competition." The subject of gas had been before Parliament in 1858 and 1859 very seriously, and was finally taken up in the year 1860, when this bill was passed; therefore the Act of 1860 was a deliberate settlement of the question between the companies and the public. That was the result of three years parliamentary inquiries into the position of the gas companies. The alteration made in the bill after its introduction arose in this way: The bill, as first reported by the committee, cut down the profits of the companies from 10 to 8 per cent.; the committee also made various alterations, which the companies considered altogether incompatible with fairness and justice. They therefore went to the House of Commons, and a discussion arose there, upon the consideration of the report of the committee, the result of which was that the bill was recommitted to the same committee. When it was recommitted, it was then that I appeared for the companies; and the bill finally took that form in which it appears now. The ground of the bill being recommitted by the House was due to the alterations and cutting down of the dividends by the committee. It was evident upon the debate that the House thought 10 per cent. should be given, and, in fact, when Mr. Sotheron Estcourt, the chairman of the committee, was addressed in the House, he gave way and said he did not mean to cut the dividend down; he also gave an explanation to show what he really intended. It was then remitted to the committee with instructions from the House, as I gather by the debate, that the 10 per cent. should be restored; so that I had no argument to address to the committee upon that point. That was the most important matter in the bill, but there was a great mass of detail in which we thought the inquiry had miscarried, and in which the committee altered the bill afterwards. In the House of Lords the bill was settled by an acceptance of the compromise in which everybody came in except the vestries. We were only opposed in the House of Lords by one vestry. The House allowed them to be heard upon all new points, but refused to let any one else reopen the compromise. I believe there has never been any application to the Home Secretary to modify the districts assigned to the companies under the Act of 1860. There has been only one case in which the Home Secretary was asked to appoint an inspector; and within a month or three weeks after the inspector was appointed, he inspected and reported, and the matter was remedied. That inquiry arose out of an accident to the purifier of the company, so that a complaint was made of a want of purity in the gas. With regard to the alleged insufficiency of the Act of 1860 upon the point of some of the legal remedies, I have only to say that it has never been tested. The Act enables the parties to obtain legal remedies for all wrongs if they please, but no one has ever tested it. They began once in the City, but it was found that the magistrate before whom the complaint was laid was interested in the inquiry, and he refused to proceed. They never resumed the inquiry before a proper, impartial tribunal. The objection on the occasion referred to was not taken by the companies, but by the magistrate himself. The complainants might have brought the matter before another magistrate had they chosen to do so. There has been no prosecution by the Attorney-General under the Act. With regard to the purity of the gas, there has been only that one complaint, and that was against the Independent Gas Company. It arose from a great extra demand for gas during the time the purifiers were being enlarged. The contractor had not proceeded with his contract according to the arrangements made with him, and for a few days the purity of the gas was not what it ought to be; but long before the inspector's report to the Board of Trade came to bear upon the company, they had remedied the evil, and no more complaint was made. It would necessarily be the result under the Act, that if the companies were earning more than 10 per cent., any penalties inflicted upon them would come out of the margin of profits after paying that dividend; but the companies now come voluntarily forward and say, "We are willing to let the penalty come out of the dividend." We have also volunteered to give 14-candle gas at a maximum price of 4s., subject to modification in case of coal or labour rising very much. There is a provision in the Act of 1860 reserving the power to increase the price of gas in the event of the cost of materials increasing so much as to necessitate it. Nothing could be more satisfactory than the working of that Act, if it be measured by the complaints that have been made under it. There is a clause in the Act by which, upon the payment of a guinea or half a guinea, or some small sum, the consumers may have the gas supplied to them examined immediately they lay a complaint, quite independently of the vestries. I was one of the witnesses examined before the committee on behalf of the gas companies last year. For some reason or other it was thought convenient to go into these legal questions last year before going to the engineering questions, in order to show the committee how the Act had worked, and to give an opportunity to our opponents to show the ground of their complaints against the Act.

Mr. DENISON read a lengthened extract from the shorthand-writer's notes of the proceedings before the select committee in 1866 (May 8), at the close of the case for the corporation, to show the nature of the concessions offered by the gas companies, and the opinions expressed by the committee upon those concessions.

Examination continued: That report of the proceedings is correct, and after the intimation of the committee then given, the companies thought it would not be right to call any more evidence. The bill of the corporation was thrown out without the companies being called upon to give any evidence against it. In his evidence on the question of capital, Mr. Beal stated that it was through him that the capitals of the water companies were reduced in 1852. I was acting for the water companies on that occasion, and attended the very prolonged proceedings before the committee, which lasted through two sessions. The committee passed the Metropoltan Water Bill, but that does not show what was done by them in reference to the capitals of the companies. The committee did not for a moment propose to interfere with any capital that had been recognized or authorized by Parliament; but every water company that came had its own separate bill in that session, except one. They had laid out very large sums of money out of the profits, and they came to the committee to ask them to recognize those sums as capital; and in order to establish their claim they brought a gentleman who was thoroughly conversant with waterworks, and also an accountant, to show, first of all, that this money had been laid out as capital; and next, that the works upon which the money had been laid out were still in existence and still in repair; and, having proved those two things, invariably without a question, the committee admitted that the profits should be added to the capital. There was no such thing as a reduction of the capital of the companies in any shape. There were certain things struck off by the accountant himself, who said, for example, "This company has laid out £350,000 out of profits on capital account, and I ask you to allow £300,000 of this. I find that £50,000 was laid out on matters which are now abolished, and I ask only for £300,000." There was no reduction whatever of the capital that had been originally authorized, either by charter or by Act of Parliament. In the case of the New River Company, the capital had never been named from its inception. The company was founded by a charter, granted, I think, in the reign of Charles the First, and it brought forward proof of an outlay of a million and a half of money; and precisely the sum which was proved under those circumstances was allowed by the committee.

Mr. DENISON: Referring to your great experience in parliamentary matters, I ask you, have you ever known any instance of a parliamentary capital, or capital authorized in any way, being violently reduced?

Witness: I never heard of such a case. Capital once recognized by Parliament we consider inviolable, and I never heard of its being interfered with.

Mr. DENISON: I think it is admitted by all the witnesses, that unless nearly all the capitals are reduced they cannot possibly carry the figures which they put into their bill—I mean consistently with leaving any dividends. The witnesses having stated that, do you think it would be entirely inconsistent with parliamentary usage to reduce the price or to increase the illuminating power, when the result must be to reduce the dividend?

Witness: I take it for granted that Parliament, having authorized the limit of a 10 per cent. dividend, will not reduce the price so as to interfere with that dividend?

Mr. DENISON: That is a matter of opinion; but as a matter of experience have you ever known that sort of thing done?

Witness: Never.

Cross-examined by Mr. RODWELL: I gave much the same evidence, only more at large, before the committee in 1866, with regard to the legal difficulties and with regard to the testing.

Mr. DAVISON read at length the remarks made by Mr. Sotheron Estcourt, on the 7th of June, 1860, when the Metropolis Gas Bill was before the committee over which he presided, to show what, at that time, was the opinion of the committee upon the main points to be settled by legislation on the subject.

Cross-examined by Mr. DAVISON: The bill of 1860 was got up by the "delegates," as they were called. The funds for paying the expenses of promoting that bill would have had to be found by them in the event of the bill being rejected. The various parishes met and consulted; they brought in the bill; they conducted the inquiry, and they were responsible for their own expenses.

Mr. DAVISON: But there was a power in the last clause of the bill for the Metropolitan Board of Works to pay the money, was there not?

Witness: Yes.

Mr. DAVISON: Therefore it was very easy to get the bill?

The CHAIRMAN: I do not understand this point to be disputed at all. I thought it was agreed on both sides that one of the advantages the delegates obtained was the payment of their costs.

Mr. DENISON: That was one of them, and that was only one of the many advantages which Mr. Beal put forward as to be gained by going on with the bill.

Witness: Only one of several. He issued a long explanation in the nature of an appeal to show that such and such advantages would be gained.

Mr. DENISON: And, in fact, they were gained?

Witness: They were gained.

Mr. DENISON: Something was said upon there being an intention to get the bill somehow in the House of Lords. Did you know anything about that? Mr. Beal seemed to say that to me. Do you confess to anything of the kind?

Witness: Not at all. The gas companies considered that they were fairly bound to consent to the bill in the House of Lords if the parties who had charge of it continued to promote it.

The CHAIRMAN: I understand you to say that after the recommittal of the bill of 1860 you, on the part of the companies, were an assenting party?

Witness: Yes; after the committee had made their final report, when we addressed the committee on the recommittal of the bill we stated we were willing to concede so and so.

The CHAIRMAN: The bill went to the House of Lords as your bill as well as their bill?

Witness: We considered ourselves pledged not to oppose it there; but if the other party had dropped it, we should not have taken charge of it.

Mr. DENISON: Was that a bill you were anxious to carry to the House of Lords?

Witness: No; there was no anxiety on our parts to get the bill passed, but having said what we had said to the committee of the House of Commons, we felt bound to offer no opposition to the bill in the House of Lords. The statement by the chairman of that committee, which has been read, was made in the middle of the case, and was what he called the impressions of the committee only, after two or three only of the witnesses for the companies had been examined, and previous to the first report made to the House.

Thomas Hawksley, Esq., examined by Mr. DENISON.

I am a civil engineer of large experience, especially in gas and water works. I have had large experience, extending over a period of 37 years, on my own account. I have been consulted by a great many of the largest gas companies in the kingdom, and by all or most of the metropolitan gas companies. I have been concerned in all the great metropolitan gas inquiries, and I have also been concerned for many of the companies privately at different periods. I was examined before the committee on the Metropolis Gas Bill in 1860. I ought to know as well as most people the cost of making gas, as well as the cost of erecting works, and everything connected with the matter; also the amount of capital, as far as it can be estimated, that there ought to be per ton of coal, and per head, and so on, which are all points gone into by the witnesses who have been called by the promoters of the bill—Mr. Hughes, Mr. Stevenson, Mr. Cleminshaw, and Professor Frankland.

Mr. DENISON: Do you agree with the calculations of any of those gentlemen?

Witness: No; I consider them exceedingly erroneous.

Mr. DENISON: As they do not quite agree among themselves we must take them in detail. First of all, with regard to Mr. Hughes's evidence, he proposes to make 18-candle gas from a mixture of Fifeshire cannel and Newcastle coal, and he thinks he can do it with a fair profit at 3s. 4d. per 1000 feet?

Witness: No; that is simply impossible.

Mr. DENISON: How much do you think it could be sold for?

Witness: The lowest price at which it could be done would be 5s. 3d.

Mr. DENISON: Dr. Frankland proposes to make 18-candle gas from a mixture of Newcastle and Wigan coal at 3s. 6d.?

Witness: That would cost 4s. 9d., but instead of yielding 18-candle gas that mixture would yield only 16¾.

Mr. DENISON: Mr. Stevenson proposes to make 18-candle gas from Newcastle coal and Wigan cannel, in certain proportions, and he agrees with Dr. Frankland in putting it at 3s. 6d, but his proportions are slightly different.

Witness: Yes; but Mr. Stevenson gets at that by taking the capital at £1 per head on the population, which is simply absurd, though I am sorry to say so strong a thing.

Mr. DENISON: It is a kind of hypothetical estimate?

Witness: No; it agrees pretty nearly with a consumption of 5 cubic feet per head in the winter months, whereas in London the consumption is more than 15 cubic feet per head. Of course they must have works proportionate. There is such a thing as £1 per head for small works under particular circumstances, but it does not apply to any undertaking like this.

Mr. DENISON: Now Mr. Cleminshaw's scheme is 18-candle gas from Newcastle and Wigan, but we do not seem to be able to make out exactly what he calculates to be the cost of it.

Witness: It is very difficult to know what he means, but the gas which he would supply by his mixture into the district is 15$\frac{2}{10}$ths-candle gas—call it 16-candle gas—and the cost would be 4s. 10d. or 58d. I am prepared to go into any details upon these points that may be required on the other side. I have taken their own memoranda and data, and those have been arranged not by me at all, in this printed form, but collected from the evidence. The printed form I will put in if the committee are willing to receive it. I have corrected those figures throughout accurately, as I believe, according to my best experience on the subject, and the corrections work out to the amounts I have given you.

The CHAIRMAN: Each calculation that was put in on the part of the promoters has been subjected by you to an examination, and this paper shows the difference between their views and yours?

Witness: Yes; what I consider to be the actual facts of the case.

Examination continued: Mr. Hughes gave evidence that 18-candle gas could be made from 3 tons of cannel and 7 tons of coal. I do not agree with him in those figures. The proportion required would be 8 tons of Fifeshire cannel to 11 tons of Newcastle coal—or what is here called Fifeshire cannel. I think he explained that it was the Lothian cannel. If the cannel he means is that cannel, it will produce 11,000 feet to the ton, of 30-candle gas, in the works, and no more. Accordingly I alter his 12,500 feet to 11,000 feet, and his 37,500 tons to 88,000 tons. I substitute for his 35 candles illuminating power 30 candles. The reason I do that is because it will not produce more than 11,000 feet of 30-candle gas; and here I may mention that I was two months engaged on this very question, in making the most accurate experiments on the different Scotch coals, at the gas-works at Glasgow, of the late John Thomas Cowper, and also in going to all the gas-works in Scotland, and to the majority of the large gas-works in England, for the purpose of ascertaining the actual facts, having no reference at all to this inquiry. I am perfectly familiar, therefore, with the productive powers of most of those coals, and I know that in practice those coals will not produce more than 11,000 cubic feet to the ton on a year's working of 30-candle gas.

Mr. DENISON: We will go now to the cost per candle, as we may call it, shortly.

The CHAIRMAN: By the cost per candle, do you mean rising from 12 candles?

Mr. DENISON: The cost per candle rising up to 20 candles—we need not go higher than 18 candles, I suppose? (To witness:) Will you give me the result of your calculations about that?

Witness: Mr. Hughes's plan corrected works out to a cost of 3·49d., and therefore it is a fact as corrected. According to my view it becomes a fact, and that fact works out to 3·49d. per candle. Professor Frankland's, in the same way corrected, but in a very different manner, works out also to 3·49d.; Mr. Stevenson's calculation corrected, works out to 3·55d. per candle; and Mr. Cleminshaw's to 3·65d. per candle. The mean of all these may be taken at 3½d., or very nearly; it is 3·54d. exactly. It is easy from these results to estimate the cost of any given number of candles. Taking 12 candles, the cost would be 3s. 6d. upon this assumption—that is, 12-candle gas would be supplied in London at 3s. 6d., with some exceptions. There are some things not taken into account here, which would be for the committee and not for me to consider. For instance, this does not allow of anything for contingencies, nor for accidents, nor for depreciation, nor for forming a reserve-fund; but this is the net actual cost of production to pay the present dividend and interest. It also allows throughout one-sixth for waste, which is as near as possible. It is called waste or leakage, but it is not so in fact; it is the difference between the gas made and the gas sold, and that is as nearly as possible the actual difference now in fact existing. I do not believe that that difference could be reduced to any considerable extent by any contrivance the companies could adopt. The waste arises in a very small proportion from the main-pipes, and in a much larger proportion from the iron service-pipes which go into the houses. They are all very destructive, being made of wrought iron. The waste also arises from over consumption by the public lamps, and also from the difference between the registration of gas by the meters in the houses and the actual quantity of gas delivered. Whenever a meter gets out of order it gets out of order against the company. If there is a little hole in the drum, the gas is supplied to the consumer without registration, supposing it is a wet meter; if the valve of a dry meter is not tight, or the diaphragm becomes leaky (which are common things), the gas then passes in a very uncertain proportion to the consumer without registration. Then there is another loss (but I do not put it at so much), and that is from what is generally called stealage—from improper dealing with the meters and tampering with them. All those things put together make up the one-sixth of waste; but I do not believe that the leakage from the mains (and I can speak with the fullest confidence on that) amounts to 3 per cent. on the whole. When the ground over a gas-pipe in London is opened a very great smell is usually perceived, but it by no means follows that the gas has just come from the gas-main. The cause of the smell is the leakage of the gas over a period of 40 or 50 years, and not the leakage of to-day. It is an accumulation of the effects produced by leakage, frequently from the junctions of the service-pipes with the main, and frequently from the decay of the service-pipe, but only to a very small extent indeed from the main itself. There has been something said about endosmosis and exosmosis, but nothing of that kind takes place in cast iron or in any metals. There is no transpiration, so to speak, of the gas from the one side of the metallic envelope and of the air on the other side—there is no interchange whatever; and when the leakage occurs there is no entering in of the air to supply the place of the gas which comes out. No such thing exists; there is no pressure of the air inwards. We are perfectly certain of that from past experience; all we know is the differential pressure, that is the amount of pressure from the inside to the outside, and there is no such thing as a transfusion, if I may use the word, through the body of any metal.

Mr. DENISON: I am told to ask you this—Does the heavy traffic of London make it more difficult to maintain the joints of the mains?

Witness: Yes; in some streets. Of course, the heavy traffic of London is confined to a few streets, and in those streets there is no doubt a considerable detrimental effect produced in the way of leakage by the continual totter to which the pipes are subjected; but even that extends more to the loosening of the junctions of the services with the mains than to anything else. The price at which 14-candle gas could be produced would be 4s. 1½d., and so on by 3½d. stages until 18-candle gas is reached, the cost of which would be 5s. 4d. This estimate assumes that the quantity of the gas sold remains much the same as at present in each district, but that assumption is inaccurate to a very large extent. It assumes that the companies will still continue to sell 8653 million feet of gas per year; but the fact is that the moment you put on a higher quality the consumption becomes almost exactly proportionately reduced. If a frost comes on and we have not gas enough to supply through the night, we throw in a lot of cannel and make a considerably richer gas, and the consequence is that every one turns the tap down, and then the gas, which would not have lasted through the night, does last through the night. That is merely by way of illustration. I have got this worked out in figures, which are very simple, and the result of them is that if the gas were raised to 18 candles illuminating power the consumption would, instead of this 8653 million cubic feet per annum, become 6450 million feet. It is right to say what would take place on the other side, because then the companies would make a fresh start: the dividend would come down to two-thirds of what it is now, and they would go on again increasing their consumption year by year until it got up again to the same quantity, and then they would be in the same position which those calculations indicate; but during the period of transition there would be an enormous loss of dividend. The parties who lent the money on interest—ordinary loans—of course would not suffer.

Mr. DENISON: Now I have a reason for putting this. You say the dividends would come down to about two-thirds of what they are. It now appears to require 1s. 4¾d. on an average to pay the dividends?

Witness: Yes; 16·77d.

Mr. DENISON: But, instead of that, if the consumption is to be reduced for some years to come in that proportion, it would want a profit of 1s. 10¾d.

Witness: Yes, at the start, and then it would go on diminishing.

The CHAIRMAN: Supposing a company to have arrived at the maximum, which, with its present works, it could supply, and to be obliged, in order to keep up the supply of 12 or 14 candle gas, to raise a very large additional capital and build new works; and suppose that company to turn to supplying 18-candle gas instead of 14-candle gas, would not, according to the argument you have been addressing to us, the necessity for that outlay of additional capital in new works be postponed to a future period?

Witness: It would be to a certain future period, but the outlay must nevertheless take place for some time before they arrived at the present standard, because all the works, almost universally (there are a very few exceptions), are fully employed, and it is only in consequence of the disasters which have happened in Parliament that they are not using new works now; they might have been utilizing the works and the capital at the present moment.

Mr. DENISON: Are you able to say, from any experience of your own, whether people are wanting cheaper gas or a higher power of gas?

Witness: I am obliged to distinguish between the intelligent part of the public and those who are uninformed on this subject. Nine-tenths of the people only look to the question of nominal cheapness, that is to say, the low figure charged for gas. There is another class of people—the West-end class in particular—who, no doubt, would be better satisfied with a higher quality of gas, and paying more for it; but that is not the feeling of the bulk of the population.

Mr. DENISON: The gas agitation seems to be rather on the subject of cheap gas than improved gas?

Witness: Yes, that is the case, not only in the metropolis but all over England.

Mr. DENISON: At all events in the metropolis it is so.

Witness: Yes.

Mr. DENISON: We have heard that the use of gas for heating purposes is increasing much. Is the higher quality of gas equally good for heating purposes?

Witness: The higher quality of gas will answer the purpose very well; but for heating purposes it is less valuable than the lower quality of gas, inasmuch as it does not give off so much heat though it gives more light; therefore you have to pay, so far as cooking goes, a higher price for a worse article.

The CHAIRMAN: But do you wish to represent to the committee that, if the subject now before us were that of a new supply of gas, it would upon the whole be better for the public to give them a cheap inferior gas than to give them a superior gas at a higher price?

Witness: It would be better to give to the public a superior, but I do not say *the* superior gas, if it is supposed that 18-candle gas is to be given, under the particular circumstances, to London, but a superior gas at a higher price.

The CHAIRMAN: Are we to understand you as representing to the committee that an inferior gas at a low price would be a greater advantage to the community, taking cooking into account, than a higher quality of gas at a proportionately higher price?

Witness: By no means.

Mr. LEFEVRE: There is very little gas used for heating purposes, I suppose?

Witness: Very little in London, but it is increasing. In some places—Liverpool, for instance—it is used enormously.

The CHAIRMAN: But we should entirely misinterpret the drift of your argument if we supposed you to be recommending an inferior gas?

Witness: Certainly.

Examination continued: The net cost of 18-candle gas, supposing the same quantity to be sold as now, would be 5s. 4d. per 1000 feet. If the companies were compelled to give gas of that illuminating power at once or very soon, it would cost about 4d. a candle to make the dividend what it is now; but I must explain that that 4d., which would press so heavily on the shareholders in the first year, would be somewhat diminished in the second year, still further diminished in the third year, and so on until the consumption became readjusted. But the effect of an important change of that kind would be seriously to injure the shareholders in the

first instance. If the companies were to be forced to give 18-candle gas, they could not afford to give it, as at present, at a less price than that fixed by the Act of 1860, which runs up to 6s. for 20-candle gas. Taking off 4d. per candle would make the price 5s. 4d. for 18-candle gas. That is the figure supposing the consumption to remain undiminished, but if any allowance is to be made in respect of the diminution of consumption, 4d. more would be needed in the first year to maintain the dividend and interest at the same rate as it is at present. The London Gas Company supply both common and cannel gas in the Grosvenor district. I have forgotten the proportion of each. I have a memorandum of it somewhere.

Mr. DENISON: You say that you entirely disbelieve in that estimate of £1 per head of population, or per ton, for capital. Have you made any estimate yourself of that? If we are to take that mode of reckoning, we should have it both ways?

Witness: First, with regard to the population, I know it must exceed £2 per head. It is difficult to be minute upon such a rough mode of calculation as that, but I will inform the committee that I am engineer of the Nottingham Gas Company, and that there, where everything is worked out as cheaply as possible, the capital of the company is £1 15s. per head on the population, and in most cases where the gas is very freely taken, there are a large number of meters to be taken into consideration, and a large floating capital is requisite. I may say there are very few towns indeed in which the capital is less than £2 per head on the population. There was a time when it was only £1 per head on the population, it is quite true, but from a consumption of 5 feet upon the population, it is now grown, in many towns, to 10 feet, and in others, as is the case in Nottingham, to 14 or 15 feet, and in London to a quantity exceeding that. When I mention that in the City of London the consumption is 50 feet per head upon the population, it can easily be imagined that no such estimate as that can apply at all. The mode of calculation adopted by one of the witnesses was so much capital per ton of the coal carbonized, and that is a much nearer way of doing it than the other; but there are a great number of inaccuracies connected with it. I will refer again, merely by way of explanation, to Nottingham. There the expenditure is £6 per ton upon the population. We have the exclusive supply of Nottingham, and there the expense of construction and the cost of labour are more than one-third less than in London. We get the brickwork done there at 12s. per cubic yard, and it is excellent brickwork; while in London it costs 25s. per cubic yard. So, again, with regard to laying the pipes in London. The cost of laying the pipes in the streets where there are all these large stones, and a great stratum of concrete beneath, is enormous; it is at least three times as much, and in many cases (in the City of London and so on), five times as much as it is in Nottingham. These modes of estimation are very rough, but the latter one is much nearer the fact than the other, because, making allowance for the difference in the value of the materials, and supposing that in all cases every work is fully employed, you can make some approximation. Still the cost obviously depends on other considerations; on the number of meters, for one thing. In Nottingham we have 17,000 meters: all those are a part of the capital of the company that has to be assessed upon the tons of coal used; then, again, we have £37,000 spent in meters, and £25,000 in the floating capital. All that has to be assessed, and so it has to be assessed upon the number of tons of coal used. What may be right in one place may be totally wrong in another.

Mr. GOLDNEY: Is the leasing of meters a profit or a loss to the companies?

Witness: It was a profit at one time, but it is not now; in most cases they lose by it since the passing of the Act called Lord Redesdale's Act.

Examination continued: In Nottingham we supply 18-candle gas at the works, and 16-candle gas in the town; it loses two candles in travelling. It is made of four-fifths exactly of the best South Yorkshire coal—Barnsley coal—which is very rich, and one-fifth of Wigan cannel. The price is 3s. per 1000 cubic for nearly the whole, coming down by slow degrees 1d. each year to 2s. 9d. for the public lamps. We only get 5½ per cent. dividend. As a matter of course, the wages are less, and the cost of production is less. The gas is what we should call 16-candle gas, but then we only get 5½ per cent. dividend. We are losing money, and we are just about to increase the price 2d. per 1000 feet. The cost of common coal has got up 1s. this year, and cannel has got up 2s.—the contract was made about a fortnight or three weeks ago—and that alone upon between 40,000 and 50,000 tons, makes a large difference. Then, again, the value of the residual products has gone down very much; tar and ammoniacal liquor are worth a great deal less than they were; and coke, in consequence of the large quantity which is being manufactured year by year, is becoming a drag on the hands of almost all the gas companies, and is forced off at a very low price. Coal and wages have on the average increased of late years at the rate of 1½ per cent. per annum, so that in 47 or 48 years it amounts to doubling the cost, and that is really what has taken place. The cost of everything in this country depends on the price of labour; there is scarcely anything in the cost but labour. The average price of coal and cannel at Nottingham last year was almost exactly 12s. per ton, and now it would be almost exactly 13s. per ton. The South Yorkshire coal is better than Newcastle coal. The average would now be rather over 13s., because cannel has risen 2s. and ordinary coal 1s. per ton.

Mr. DENISON: Some of the witnesses were advocates for uniformity of price, and they pointed out that one side of a street may now be supplied at 3s. 6d., and the other side at 4s. Can that be avoided in a great place like London, divided as it is?

Witness: Certainly not. In many places Parliament has spontaneously enforced differential rates, even in towns where there is only one company. The inner circle is on a low price, and the outer circle has an increased price. That is the case at Nottingham, among a great many other places. The difference there is 1s.; so that at Nottingham you may, at a certain place, have gas at 3s. on one side and 4s. on the other. If the boundary of the district passed between two adjacent houses, there would be a different price for each, but I do not know of such a case. I am aware of the offer which the metropolitan companies made last year through Mr. Hope Scott.

Mr. DENISON: Does it occur to you to suggest anything else which can consistently with the rights of the shareholders be offered to the public?

Witness: I think that on one point there is something. I believe that a better system of audit might be introduced, which would be satisfactory to the public, but it should be only a limited audit, having regard, in the main, to two or three things, so as not to limit the discretion of the directors. The audit should be directed, in my opinion, to the proper apportionment of the outlays between the capital and the revenue; that is very material. If much is made of that by any of the witnesses, we are willing to concede that suspicions have been excited that the companies are dealing improperly with the capital and the revenue. I have reason to believe that there are no such improper dealings, but in order to satisfy the public on a point in which no doubt they are interested, it would be very desirable that the auditor should pay particular attention to that point.

Mr. DENISON: As the evidence of last year is referred to the committee, and as you were examined last year about the sulphur in gas——

Mr. O'MALLEY: We are not going into the question at the present time.

Mr. DENISON: The word "purity" was used, which, as a matter of course, includes sulphur.

The CHAIRMAN: Do you mean that you do not ask any conditions with regard to that?

Mr. O'MALLEY: Yes, on the other parts of the bill, we do.

Mr. DENISON: I do not care when I do it, but you used the words "purity," "illuminating power," and "price."

The CHAIRMAN: Yes.

Mr. DENISON (to the witness): It is very difficult to determine first of all, the quantity of sulphur that there is in the gas.

Witness: Very difficult; there are great disputes upon the subject. It is exceedingly easy to find the quantity of sulphur in the form of sulphuretted hydrogen, but it is extremely difficult to find the quantity of sulphur in the form of bisulphide of carbon or in any analogous compounds, because the first is impossible to test and the other is not. But there is among philosophers and chemists at the present time the greatest difference of opinion on that subject; one man will bring out a result of 20 grains where another contends for 60 or 70 grains.

Mr. DENISON: With regard to getting out the sulphur, is there any difference in those two forms with respect to the power of getting rid of it?

Witness: Any strong alkaline matter will get rid of the bisulphide to a very large extent, and if it were possible to reintroduce the use of lime into the gas-works of London, the gas would be very materially improved and the quantity of sulphur would be reduced to one-half of what it is now. But then we have another class of philosophers to deal with—viz., sanitary philosophers, who object to the use of lime, because they say that the smell is a nuisance, and so on; and the gas companies of London have been driven to use oxide of iron, which has no chemical effect upon the bisulphide, although it acts in a most powerful degree on the sulphuretted hydrogen.

The CHAIRMAN: I think you have stated that the greater part of the loss from leakage was from the service-pipes and not from the main-pipes?

Witness: Upon a comparison between the main and the service pipes, unquestionably the greatest loss is from the service-pipes; but I did not mean to convey to the committee that it extended to a very large proportion of the one-sixth. Taken on the mains only, it would be limited to 3 per cent.

The CHAIRMAN: Now if, either in the hands of a company or of any competing supply, large works were placed at a considerable distance from London, down the Thames, would there be a great loss in what is called leakage from the mains between that place and the centre of London?

Witness: No; it would be almost nothing.

The CHAIRMAN: Would there be any objection on the part of the sanitary philosophers, as you call them, to using lime at such new works?

Witness: I think not; I think there ought not to be. The difficulty is in getting rid of it for any useful purpose. Agriculturists over a large part of England will scarcely take it. There are certain places, such as Yorkshire and a few other places, where the farmers will take it with avidity; but in all other places it is a drag, and I do not know how, on the margin of Essex, so large a quantity could be disposed of. Why the farmers are averse to use it I cannot say. We have now at Nottingham, in the middle of a fine agricultural district, an accumulation of about 2000 tons, which we do not know what to do with. We would give it away to any farmer who would pay us a shilling a load for it.

Mr. DENISON: Now, to follow out this suggestion of carrying the works down the Thames, could the gas be carried right through London without any difference in the pressure?

Witness: The difference of pressure would of course be very great, but the loss of gas on a well laid main-pipe is very insignificant indeed. I am able to speak in the strongest possible manner on that subject, because I have been laying very recently main-pipes many miles in length. My practice is to put a meter on to the main before it is used for any purpose whatever, so as to ascertain whether it is properly laid or not; and in a recent experiment, the loss upon, I think, four miles was only about 200 feet in 24 hours. The main varied in size from 10 inches down to perhaps 6 or 7 inches.

Mr. DENISON: What sized main would he required for having the works somewhere down the Thames, and carrying the gas from there up to London?

Witness: They would be enormous. I am surprised at the result of the calculation, and should like to go through the figures again, but the result is, that it would take nearly 20 mains of 3 feet diameter.

Mr. DENISON: Or one main of 13 feet diameter?

Witness: That would be impossible.

Mr. GOLDNEY: Take 4 feet.

Witness: It would be 11 or 12, or something of that kind. But there is a great difficulty in the introduction of large mains in London, because the streets are already so occupied with gas-pipes, water-pipes, telegraph-pipes, sewers, and all manner of contrivances, that a very large pipe cannot be got through the principal streets. I believe it is now pretty well known that a 3-feet pipe is about the limit with which you can deal in London.

Mr. DENISON: I find that last year there was some evidence given in favour of the Corporation Bill, which was rejected, and Mr. Clift then stated, in answer to a question which was put to him, that he proposed two mains which were 40 inches in diameter. That was in the City of London alone?

Witness: Yes, only to supply the City.

Mr. DENISON: I understand you to say that neither with the eleven mains of 4 feet, nor with the one pipe of 13 feet in diameter, nor with the twenty pipes of 3 feet in diameter, could you practically carry the mains from some place down the Thames to supply all London?

Witness: No; concentration beyond a very small amount is always effected at a very great loss. I should like to explain that very particularly. If I had a district to supply, the length of which may be represented by the upper part of this quill, I only want a main of the diameter that is represented by the quill itself. If, however, I have a large district to supply, a much larger district, say a district which may be represented by the whole length of the quill, I must then have a main beginning at the larger end, which is the size of the quill. Now the average of the size of the main is not the average of the feathery end of the quill at all, as it would be if I could divide it into two, and supply each of them from two separate stations. I should then only want a main from each, which would be represented by the thin end of the quill; but if I take it from a concentrated station, I want a main which is represented by the thick end of the quill, because I must carry to this thick end not only the gas required for

distribution in that district, but plus that all the gas that is wanted in the other district. And, consequently, it does occur that concentration is a very expensive thing indeed, and accordingly (I am referring again to Nottingham) we take gas from the works at three points of a triangle, and then each distributing over the district the one helps the other, all the mains being united, and we have the mains only at the thin end of the quill, whereas otherwise we should want mains at the thick end of the quill.

Examination continued: Any such re-arrangement of the companies as to put the works outside London, with new mains, would involve a very enormous cost—which no doubt would be measured by several millions at least. The cost, in London, of constructing gas-works is about £240 per retort, whereas, in the country, we can do it at about £160; that is, for the stations alone, without the mains. With regard to the impurities of gas, a great deal more sulphur is evolved from burning coal in the fireplaces of our houses than from burning the same quantity of coal in gas-retorts and making it into gas, because in the latter case there is a certain quantity left in the coke; another very large quantity is taken up by the lime and ammoniacal liquor, and only a very small proportion—about 20 grains out of more than 200 grains—is left in the gas. Crude gas usually contains somewhat more than 200 grains in the 100 cubic feet, whereas after purification it only contains about 20 grains, so that 9-10ths are taken out and 1-10th is left in. The injury which gentlemen complain of as being done to their boots, and their books, and things of that kind, is done by the sulphurous acid in the air rather than by the products of the gas.

The CHAIRMAN: Is there a controversy on that part of the bill which relates to the purity of the gas?

Mr. O'MALLEY: There is, but we have not opened that part of the case. At all events there is a mode of purification suggested which we propose to offer evidence upon.

Mr. DENISON: The effects of sulphur, spoken about last year, are due in a very much higher degree to the coal burnt in our own fireplaces than to the gas made in the gas-works.

Witness: Yes; but the effect is due in the main, not to the sulphur at all, but to the heat of the atmosphere. In places where no gas is burnt, if there is considerable heat the leather of boots becomes very much dried, and the binding of books decays with very great rapidity. At the same time, I am not indisposed to admit that any quantity of sulphur has, of course, the same effect.

Mr. DENISON: I have got a note of your evidence at the word "ammonia." I conclude you have something to say about that, unless we had better postpone that.

The CHAIRMAN: I take some blame to myself, but I did not understand that you were going at such length into this.

Mr. DENISON: Well, take the public lamps—that is a question of price; there is often a controversy whether they should be supplied at a lower price or not?

Witness: They are the worst consumers that a company has. Every public lamp is a sort of little consumer of one light; it has its own separate service-pipe and its own separate leakage; it has all the wasteful incidents of a single jet consumer, and the supply of public lamps is the most expensive of any supply which a gas company gives. This effect is produced through supplying those lamps at an unduly cheap rate, so that what is taken off from the price charged to the public lamps is put on other consumers. The company has to make up its dividend, and what it cannot get out of one supply it gets out of another. The effect is to relieve the non-gas consuming public of their rates at the expense of the gas consuming public.

Mr. DENISON: Now, a word about the burners. I suppose you know the views put forward on the other side about the different burners in use in 1860 and now. Do you agree with those statements?

Witness: I do not. They are not founded on facts. I used as good a burner in the year 1860 (it was a commercial burner, which anybody could have) as has ever been used or contrived since.

The CHAIRMAN: We have agreed to suppose, up to the end of these discussions, that when we mention any particular number of candles, we are speaking with regard to the year 1860, and that if we change that for any new burner, we shall make due allowance for the change.

Mr. DENISON: It is stated against us that when we offer to give 14-candle gas by Sugg's burner, we are only offering to give substantially the same as we gave under the name of 12-candle gas in the year 1860.

The CHAIRMAN: Yes, but by putting in Sugg's name in that statement you have entitled us to assume that you have given us two candles more.

Mr. DENISON: Quite so.

The CHAIRMAN: We shall feel ourselves quite at liberty to insist upon that.

Cross-examined by Mr. O'MALLEY: I do mean to represent to the committee that at Nottingham we pay only 5½ per cent. dividend upon our capital. Our entire capital has not been doubled by the operation of Acts of Parliament. There was a certain portion of the capital in the year 1849, or thereabouts, which was doubled, and the dividend on that capital was reduced one-half. Then we were required to sell our shares by auction, and apply the premiums received to capital account without paying any dividend upon it. The one has almost exactly balanced the other by this time, so that the capital I told you is the real and actual capital invested in the undertaking. I think it was £40,000 which underwent the operation of being nominally doubled, making £80,000 bearing half the rate of dividend. The capital of the company now in use is £264,000.

Mr. O'MALLEY: Is it paid-up capital?

Witness: It is, and it is not. £40,000 of that is not paid up in calls upon the shareholders; but more than £30,000 of it has been realized by premiums on shares sold; the one very nearly balances the other, and therefore I may, truly enough, say to this committee that, within a mere trifle, which I cannot state at this moment, the sum I have mentioned is actually in use on the works.

Mr. PEEL: What is the actual amount of money received from the shareholders directly as payment upon shares—independently of any premiums, but simply paid-up capital?

Witness: The amount of the share capital is £230,000, and borrowed money £34,000. The £230,000 includes the duplication of the £40,000, so that the money paid up on the calls would be about £190,000. Then, in addition to that, there is the money that has been brought in by the shareholders not arising upon the calls, but arising on the premiums, and that amounts to somewhere about £30,000.

The CHAIRMAN: Without going into the minutiæ of your financial accounts, you state to us that the capital you describe as bearing the 5½ per cent. dividend has all been laid out, and is now existing in the form of works which are used in the supply of gas to the public.

Witness: Yes; that sum and something more.

Cross-examination continued: All our capital pays 5½ per cent., but, taking into account the duplication, there is a portion which would (but for the duplication) be paying 11 per cent., and there is another portion which pays nothing at all, and that balances the one with the other. I was examined in the year 1860, and undoubtedly I stated then that some part of our capital pays 13 per cent., some 14 per cent., some 10 per cent., and some 5 per cent.; but it is subject to this explanation which I am giving. I cannot tell how much pays 5½ per cent., but it is a very large quantity. I am the engineer of the company, and am acquainted with everything, but I do not carry everything in my head, still I can tell you by a calculation. I cannot tell within £10,000 off hand, because I have not the figures before me; but I can make a calculation, for I know the facts.

The CHAIRMAN: I may be mistaken, but I do not think there is any controversy between you on the point. I understand the witness to say that the whole of the capital, upon an average, pays 5½ per cent., and that the whole of it is in existence in the shape of works in actual use, but that there are subordinate arrangements among themselves by which a portion of their capital has no right to any dividend, and another portion has a right to a higher dividend than 5½ per cent. Is that a correct view of what you have been saying?

Witness: It is perfectly correct.

Mr. O'MALLEY: Your nominal capital is £264,000?

Witness: Yes.

Mr. O'MALLEY: How much of this capital has been paid by premiums on shares put up by auction?

Witness: I really cannot tell you, but I will try to make the calculation for you if you like, and I will tell you after it is made as nearly as I can.

Mr. O'MALLEY: Did you not tell us, a few minutes ago, that you expected to be able to do so, because you said that £34,000 was the amount of the premiums paid?

Witness: No; I said that £34,000 was the amount of the borrowed money.

The CHAIRMAN: If you really want to shake the credit of the witness, I do not like to stop the cross-examination; but I do not think there is any real controversy between you. Do you mean, Mr. O'Malley, that you do not believe his statement?

Mr. O'MALLEY: Unquestionably, according to my instructions, I do not believe his statement.

Witness: If you would let me tell the whole of the story, it would not take one-fourth of the time.

Mr. O'MALLEY: What was the amount of the last dividend that you paid?

Witness: £12,650.

Mr. O'MALLEY: You cannot tell me what amount of capital pays 12 per cent., what amount pays 14 per cent., and what amount pays 10 per cent.?

Witness: No; but if you will let me explain that, instead of repeating the question without giving me an opportunity of answering, I will try and do so. In the year 1818 the company was incorporated, with a capital of £16,000, and it went on with that capital till the year 1840.

The CHAIRMAN: The only point which is relevant is, how far the example of Nottingham illustrates the price which we should put into this bill; and Mr. Hawksley seems to have gone into that subject at great length on the 14th of June, 1860, in the Blue-Book which is referred to us.

Mr. O'MALLEY: I forgot that that evidence was referred to the committee, sir.

Cross-examination continued: We deliver 16-candle gas at the consumers meters in Nottingham, and make between 18 and 19 candle gas at the works. I was examined as a witness before the Brighton Committee last year in a very peculiar way. I was asked as to the standard of illuminating power at Nottingham.

Mr. O'MALLEY: Did you say this: "The standard under the Act of Parliament is, I think, 12-candle gas, but we have found it desirable to improve the quality of the gas from time to time, until now we send it out of the works at between 18 and 19 candles, and we deliver it into the town at about 17"?

Witness: I have no doubt that is true if you have got it there.

Mr. O'MALLEY: Is there anything after that?

Witness: Nothing, except the fluctuations in the quantity of the coals, and those fluctuations are all indicated in the papers I have here. I do not know whether at that time I said that we produced that gas by using one-fifth cannel coal; but it is a fact that we do. It is very likely I stated that at Brighton 15-candle gas could be produced at 12¼ per cent. of cannel coal; it is about that, I should think. I cannot tell whether I said so. I have not read the evidence; I do not possess it; but it agrees very well with the facts.

Mr. O'MALLEY: Let us have it clear: if it is 12½ per cent. now, be it so. Were you a witness upon an arbitration between Mr. Croll and the Great Central Gas Consumers Company?

Witness: I think I was, but I am not very certain. I was prepared to be a witness, but I recollect nothing of the fact (it is a good many years ago) as to whether I was called or not. I attended the arbitration to a certainty.

Mr. O'MALLEY: Do you remember that the contest between them was a contest about 18-candle gas?

Witness: No; I do not.

Mr. O'MALLEY: Did you say this: "I think 1d. per candle per 1000 feet is a fair price for increase beyond 12 candles of 140 grains"?

Witness: I am certain that I did not.

Mr. O'MALLEY: Will you look at this book?

Witness: No; allow me to finish. Mr. Croll was a mere manufacturer of gas into the gasholder; and it might be, and probably was so, that it would only cost Mr. Croll 1d. per candle more to put that gas into the gasholder; but then there was also the other question—you would have to add the expenses of the company, the expenses of the dividend, and various other things.

Mr. O'MALLEY: I am not asking you the expense of the dividend, or anything of that kind, but did you say that 1d. per candle was the increased price of the material for making it?

Witness: I really cannot tell you. I do not know, for I have not the most remote recollection. If you inquire whether I said so and so, you know the rule is to put the paper from which you are questioning me into my hand first, and let me read it.

Mr. O'MALLEY handed the report to witness.

Mr. RICHARDS: What is that print?

Mr. O'MALLEY: It is a print of the evidence that was given on Croll's arbitration.

Mr. RICHARDS: It is a print of which we know nothing whatever.

The CHAIRMAN: The witness is asked whether upon a former occasion

he said a certain thing: that is a fair question. Then he himself asks to look at the report of what he said, from which he is being questioned.

Witness: This is altogether a different thing; it is quite amusing when it is understood.

Mr. O'MALLEY: Will you explain it?

Witness: This only relates to the use of common coal, and the question is simply as to some claim made by Mr. Croll with regard to a difference in illuminating power, with common gas, upon a contract which he had. He stated that in consequence of some legislative interference he had been obliged to improve the quality of his gas a little, and the question was, within what limits and at what price the company should pay him for that small improvement. I have given what I believe to be a very fair answer upon such a question as that; it relates to a question as between 10½ candles quality and gas of 12 candles quality.

Mr. BURKE: Not 18, as was stated?

Witness: No, it has nothing to do with the question raised before this committee. What it turns upon is simply this: whether a man using the same coal shall distil it a little less to get off the strong gas, instead of distilling it a little more to get off the weak gas; the whole question was whether Mr. Croll should have for that operation an allowance of something more, and I there stated, apparently without much calculation——

The CHAIRMAN: Never mind what you did state. The question put to you was whether it was a question of raising 12-candle gas up to 18-candle gas.

Witness: No, not at all; it did not involve the use of cannel coal at all.

Mr. O'MALLEY: You have told the committee now that it was a question of raising it within the limits of common Newcastle coal. To what limit?

Witness: To 12 candles.

Mr. O'MALLEY: It was 12 candles you started from?

Witness: No, it was not. The parliamentary standard in the bill which was passed by the committee of which the right honourable chairman of this committee was also the chairman, was 10 candles.

Mr. O'MALLEY: You have not answered the question I asked you. Your words are, "I should think one penny per candle per 1000 feet a fair price for increase beyond 12 candles of illuminating power."

Witness: There was a contract between Mr. Croll and the company, under which Mr. Croll was to make their gas for them into the gasholders at something like, if I remember rightly, 16d. per 1000 feet. Mr. Croll was simply a manufacturer of that gas. Then some legislative change took place, and the quality of the gas had to be slightly raised, and the company and Mr. Croll got into litigation about the contract. It was referred to arbitration, and I was asked the question as to what would be a fair compensation to him as a contractor for the small change in the quality of the gas.

Mr. O'MALLEY: Have you any objection to this book being referred to as a test of your evidence?

Witness: Yes, I have, certainly, because I know nothing about the book, and I cannot say that it represents truly what I said.

The CHAIRMAN said the book must be put in regularly if the committee were to take cognizance of it.

Mr. O'MALLEY: Do you mean to state to the committee that the question was about raising the gas to 12 candles?

Witness: No, I do not say either one way or the other, because it was a great number of years ago, and I have no recollection upon the subject except what I see in this book.

The CHAIRMAN: You told us just now that there would be a difference in the price per candle according as it was calculated, not as between the company and the consumer, but as between the company and the contractor, the contractor only being concerned with the manufacture of the gas for the company?

Witness: Yes.

The CHAIRMAN: Did I understand you to say that 1d. per candle would be a fair amount, put in that latter regard only?

Witness: Not at all.

The CHAIRMAN: Then what is the difference in your opinion? You told us that 3½d. would be about the price in the former of those two regards, did you not?

Witness: Yes; 3½d. is the actual additional cost.

The CHAIRMAN: But in one of your former answers you have drawn a distinction between what ought to be called the charge per candle as between the company and the consumer and as between the company and the contractor?

Witness: Yes.

The CHAIRMAN: Did you mean your 3½d. to be as between the company and the consumer, or as between the company and the contractor?

Witness: Between the company and the consumer.

The CHAIRMAN: Now, will you tell us what you think it ought to be as between the company and the contractor?

Witness: That is very difficult to say, without an independent calculation for the purpose. In the case in question, perhaps, you will allow me to state that it was only a question of distilling off so much more or so much less gas from the same quality of coal, and there is a great difference between using these expensive coals which are now spoken of, and which would come to 40s. a ton, and the case of that company which was actually getting its coal at the time, I believe, at 12s. a ton.

The CHAIRMAN: But I want to pursue the question. I do not care about any bygone controversy between Mr. Croll and any one else; that is of no consequence to this committee. What I want to know is, what are the considerations which influence you in fixing 3½d. as between the consumer and the company, and in fixing some smaller sum as between the company and a contractor?

Witness: In the first place, what I have calculated here is the actual cost of the commodity delivered at the consumer's meter, taking into account the loss of one-sixth, which enters materially into a calculation of this kind. Then I have, in the case as it presents itself now, to take into account the great increase in the cost of all coals.

The CHAIRMAN: The contractor would have to pay for the coals, would he not?

Witness: The contractor would have to pay for the coals, but pardon me for drawing your attention to it, in this way—if the contractor is bound to buy cannel coal he gets a less quantity and a worse quality of coke.

The CHAIRMAN: I am not going through the argument. You have told us that when you estimated 3½d. as between the company and the consumer, you included a great many considerations which, as between the company and a contractor, you would not have included. I want you to exclude those considerations, and to furnish us with your opinion as to what it would be as between the company and a contractor.

Witness: I will endeavour to make it clear to you, but the difficulty is in reducing it in a moment to calculation.

The CHAIRMAN: There cannot be a difficulty in reducing it, because you must have begun in that way. The foundation of your larger calculation must have been the smaller one, which I want to have.

Witness: I beg your pardon; I think not at all.

The CHAIRMAN: Before you added those charges for depreciation and the other things which you say it is just to take in as between the company and the consumer, you must have begun with the actual cost, which is what I want, as between the company and the contractor. Will you state what that actual cost was, which was the basis of your calculation of 3½d.?

Witness: I will tell you. The cost arises first from the large proportion of cannel coal which has to be introduced. It arises secondly from the diminished value of the products in a case in which cannel is used. It then is affected by the amount of the leakage, which the other case is not, and consequently what as by way of compensation might be a fair sum to give to a contractor who has only to deliver the gas into the gasholder, and has not to change the kind of coal he is using, is very different from what it would be in a case where he has to do all these things.

The CHAIRMAN: I do not want you to argue with the committee why there should be additional considerations as between the company and the consumer, to those that would be taken as between the company and the contractor. I simply want you to state, in the calculation of your 3½d. between the company and the consumer, how much would be the simple charge as between the company and the contractor, and how much would be due to the rest?

Witness: I will endeavour to make it out, but I cannot instantly answer the question. The difference appears to me, at present prices, about 2½d. or 2¼d. per candle. That 2¼d. or 2½d. is due to the difference in the cost of manufacture. The other 1d. or 1¼d. is, without going into minute calculation, due to leakage and the difference in the cost of the materials of manufacture between that date and the present time, because all that was taken at the cost of coals at that date, whereas the cost of coals from which the companies are now manufacturing gas is quite 25 per cent. greater than it was to Mr. Croll.

The CHAIRMAN: That has nothing to do with the question I am asking you. You have told us that, to raise gas from 12 to 18 candles—or from 14 to 18, I think it was—the fair allowance is 3½d. per candle. I presume, therefore, that at Nottingham, for instance, if you were now supplying 16-candle gas, and the consumers would be content with 14-candle gas, you would be content to take 7d. off the charge?

Witness: No; because at Nottingham the cost of coal is not so great. We are now only paying 23s. or 24s. a ton for cannel there, and about 11s. a ton for common coal; whereas the common coal in London is 16s., and Wigan cannel—to say nothing of the other cannel—is about 27s. All that enters very largely into the cost per candle.

The CHAIRMAN: But there is a manifest confusion, which I want to draw you away from. When you told us that 3½d. was the proper sum to take as the increased cost per candle if we raised the illuminating power from 14 to 18 candles, you said that, besides the actual cost of manufacture, there were certain other things which you thought ought to be taken into consideration, did you not?

Witness: Yes; but that was an addition to the 3½d.—not as forming a part of the 3½d.; and I beg to call your attention particularly to that, as it happens to be corroborated by the figures at the bottom of this paper [handing same to chairman].

The CHAIRMAN: All I want is to come to a clear explanation, that the committee may distinctly understand what they are to take as your testimony. We have hitherto understood that you advise us, if we raise the illuminating power in London from 14 to 18 candles, we ought to add four times 3½d. to that cost?

Witness: Certainly.

The CHAIRMAN: Is that the exact sum, or ought we to add more?

Witness: That is the exact sum which would keep everything as it is now, provided there was no diminution of consumption. But it does not allow anything for depreciation; it does not allow anything towards a reserve-fund, but gives the companies exactly 16¾d. per 1000 feet for their dividend and interest as they have now; it allows no margin.

The CHAIRMAN: Have the committee correctly drawn from you that when you made the calculation which led you to tell us that we ought to allow 3½d., you had in your mind from 2¼d. to 2½d. as due to the cost between the company and the contractor, if there was a contractor, and the other 1d. or 1¼d. as due to those other considerations you have spoken of?

Witness: No; what I did was this—I calculated the utmost expense, without reference either to a company or a contractor. I had nothing to do with a contractor; the idea of a contractor never presented itself to my mind; I found what the cost would be to the company.

The CHAIRMAN: Does the 2¼d. or 2½d. represent what the cost would be to the company exclusive of these other considerations.

Witness: No, it is insufficient. When I speak in this way, I mean it to be understood that I have not had time here to take every little matter into account, but so far as I can calculate it now it appears to be about 2¼d. or 2½d. But then there is the question of leakage besides, which enters into the consideration in a very important manner, because if we sell only five-sixths of our gas instead of selling six-sixths it influences our dividends, the cost of labour, and everything else; whereas what I have given you is the exact answer to what I understood the question to be. The cost of manufacture, including all the expenses of the company, is 19¼d. per 1000 feet, but I cannot on the instant analyze this amount into its several elements so as to show all the details, but I can and will do it with pleasure.

The CHAIRMAN: Will you tell me what you meant when a short time ago you told me it was 2¼d.?

Witness: I was then asked as to a contractor. The 2¼d. is the difference in the cost of the coals and the value of the residual products, but there are various other matters to be taken into account which are beyond what I am now speaking of; but that is as much as I can give you on the instant from the papers I have before me.

The CHAIRMAN: Then do I understand you that, taking a balance of the cost of the coal and of the residual products together, the companies would lose from 2¼d. to 2½d. per candle?

Witness: No, they would lose 3½d., but they would lose about that within the walls.

The CHAIRMAN: What would they lose within the walls?

Witness: They would lose one-sixth of the whole gas, which would affect, of course, other elements of cost besides that. I can only give a general answer to the question as you put it, but if you will permit me to state how the calculations of cost are made I think you would find that this difficulty would not arise at all.

The CHAIRMAN: Then let us hear it.

Witness: The way in which the calculation of the actual cost is made is this: I take the cost of the coals, I take the production of the coals, and I

take the illuminating power of the coals. Then, for instance, assuming Mr Hughes's plan to be adopted, I find that I could get at the works 20 candles from that quantity of coal, and at the cost of the coal stated. I then know as an actual fact that the reduction of quality before the gas arrives in the district is, upon all qualities of gas, as nearly as possible one-tenth. I therefore take off one-tenth of the 20 candles, which is 2, and that gives me 18 candles in the middle of the district. I then find, after allowing one-sixth for waste, which is an ascertained fact, that I can get from this quality of coal 8684 cubic feet per ton for sale, after allowing the one-sixth. I then find that the cost of those 19 tons is £22 16s. I find the products resulting from the carbonization of these 19 tons to have a value of £7 14s. 9d.; that gives a net cost of £15 1s. 3d. for the coals. I have got 19 tons for £15 1s. 3d. These are actual facts. That gives me as the net cost of one ton, 15s. 10d. Then I divide that 15s. 10d. by the 8684 cubic feet sold, and that gives me a cost for coals of that quality of 21·87d., that is 18 candles. I have now got, as you find, from actual facts, without troubling myself with mere estimate, that the cost of manufacturing in London is 19¼d., and I find (Mr. Hughes has admitted it) that the cost of the fuel for carbonizing 1000 feet is 5d. That gives me 24·25d. to add to the cost of the coal. The cost to the company, therefore, without any profit, is 46·12d. Then the actual amount of the interest on borrowed money, the dividend on preference shares, and the 10 per cent. on the unsecured capital, is 16·77d., assuming always the same quantity of gas to be sold. These are all facts; they do not depend at all upon estimate.

Mr. GOLDNEY: You have arrived at 46·12d. as the cost of 18-candle gas. Now can you give me the cost of 14-candle gas? That will give what the right honourable chairman is asking. He wants to know the difference. If you give us the cost of 14-candle gas we can subtract it.

Witness: I think I have it somewhere. There is a paper missing which would have answered it.

The CHAIRMAN: We will give you till next Tuesday, when we meet again. By that time, perhaps, you will be so kind as to furnish us with the analysis of these figures, informing us what the 2¼d. or 2½d. of which you have spoken includes, and what are the other matters that go to raise it up to 3¼d.

Witness: I will.

Mr. O'MALLEY: I should like to reserve my cross-examination until then, because I have a few other things to ask.

The CHAIRMAN: You had better go on with the other things.

Cross-examination continued: In the Brighton case I stated that 15-candle gas could be produced by the use of 12½ per cent. of cannel. I have no recollection that I said that the mere extra cost upon the 12½ per cent. would not amount, I suppose, to more than 1½d. or 2d. per 1000 feet; but I can give you what it would be. With regard to the £2 per head for capital, I have not said that 7d. per 1000 feet pays our interest or our dividend at Nottingham. I think it is between 9d. and 10d. We have increased our capital considerably since last year. I do not know the amount of the increase; a large portion of the money that has been borrowed having been borrowed recently. I cannot tell whether I said last year that 7d. per 1000 feet would pay our dividend. We make 390 million feet at Nottingham, so that it is easily calculated. Our capital is about £1 15s. per head. Very much less than 28s. or 30s. per head capital is possible in some places. The concentration of the area of supply has some effect upon this point, but that, of course, only affects the question of mains. For mere construction, 28s. per head at Brighton, and for the cost of materials at Brighton, would do very well; it would not be sufficient for everything. I was engaged for the Imperial Austrian Gas Company, which was established to light, not Vienna, but 12 or 14 towns in Austria. It is perfectly true I gave it as my opinion that, taking their representations to be well founded, £1 per head of the population would not be an unfair amount to pay for the works, all English contractors to do them, and to be paid very largely in paper. If it had been paid in money, 16s. per head would have been abundant. Will you allow me to explain that that referred to a specific contract for 2½ cubic feet per head. That is the absolute contract under seal; and, of course, 16s. would have been abundant if they could have paid for it in cash, and 20s. if paid partly in paper. Here we supply six times as much per head—more than six times as much.

Mr. RICHARDS: I do not propose to re-examine the witness now, because he is coming again to answer the questions the committee have put to him.

The CHAIRMAN: I have failed, as far as my lights are concerned, of getting sufficient illuminating power upon this 3¼d., and I want to have it so far explained that if the committee are to attach any importance at all to it we may know what it was founded upon and what it consists of, and what difference there is between the cost as furnished by a person in Mr. Croll's position under that contract to a company, and as afterwards furnished by the company to the consumer. I wish to have those different elements separated, but I by no means propose to interrupt Mr. Hope Scott's statement by interposing a long examination on general subjects.

Mr. RICHARDS: I understand my learned friend to say that when that statement is put in he proposes to cross-examine upon it.

Mr. O'MALLEY: No. I will not ask anything; I waive it.

Re-examined by Mr. RICHARDS: I believe the contract with Mr. Croll was a contract for the supply of wax-candle gas, and not sperm, and therefore when I was talking about 1d. per candle I was talking about wax candles. I may tell the committee it is a well-known fact that 13 wax candles are equal to 11 sperm candles.

The CHAIRMAN: We assume that there was a clear understanding in 1860 as to what sperm candles meant, and what wax candles meant, and that we mean the same things now. We do not care a farthing about Mr. Croll and Mr. Croll's arbitration any further than that the witness says that when he speaks of the cost per candle as it would be as between a contractor and a company, and as between a company and the consumer, he draws a broad distinction. We can recognize that, and we only want what he is not able to tell us now—viz., of the 3¼d., how much is due to that and how much is due to other things?

Mr. O'MALLEY: My learned friend is wrong in saying it was wax candles in that case. It was sperm candles of 140 grains. Here it is in Mr. Barlow's book.

Mr. RICHARDS: You were examined in the Brighton case, and you say that at that time you said you made from 18 to 19 candle gas, and delivered about 17-candle gas in Nottingham?

Witness: Yes; at Nottingham—not at Brighton.

Mr. RICHARDS: You said you used one-fifth of cannel and the other four-fifths Barnsley coal?

Witness: Yes; one-fifth cannel and the other the best Barnsley coal.

Mr. RICHARDS: That is precisely what I understood you to say now. You make 18; you deliver somewhere about 16; and you use four-fifths of Barnsley coal, the other one-fifth being cannel?

Witness: Yes; the whole confusion arises upon the question of the cost of material, the cost being the cost of a different material from that which was contemplated in the other case, and consequently the difficulty I am in now is in comparing the two circumstances, which are utterly different. If they were parallel circumstances, I could compare them easily. I shall be prepared on Tuesday to give that explanation to the chairman, if he wishes it.

The CHAIRMAN: I suppose you can get access to a copy of the evidence in the Brighton case. I should certainly like to have an explanation of the answer to which Mr. O'Malley has pointed our attention when we meet again on Tuesday.

Witness: I do not know where I can get a copy.

Mr. O'MALLEY: The solicitor will give you a copy.

Mr. RICHARDS: The usual course is, if a witness is asked a question upon a document, to put the document into his hands.

Mr. DAVISON: When we come to the question about the burners it occurred to me that perhaps the committee might like to see the actual burners in working. It is easily done; I believe it was done last year. The gentlemen who will be called upon the point will explain as they are passing along what is going on.

The CHAIRMAN: I think we must see our way by degrees. I want to see it accurately as we go along. I do not want to get to anything about the burners and schedules till we have settled the bill.

Mr. DAVISON: It would take some time to get the preparations made. If you think you would like to see the burners by about Tuesday we could prepare them.

The CHAIRMAN: I dare say Dr. Percy would show us anything of that kind that we wanted to see.

Mr. DAVISON: It was put up in the committee-room last year. I only thought you would like to see it.

The CHAIRMAN: If it is a thing to be controverted, probably, as there is a distinguished scientific gentleman on these very premises, who would, no doubt, be ready to give us any assistance in his power, you had better arrange it between yourselves and him, and then we should see something that you had agreed on, instead of something about which there would be a controversy.

Mr. DAVISON: I do not desire to pursue the point, but you will allow me to mention that in this House you are burning cannel gas only, and therefore the experiment would fail.

The CHAIRMAN: When the time comes we shall be very ready to deal with the question; I want to get this part of the matter done with first. I think you have told us that with regard to the purity of gas there would be a great advantage in reverting to the plan of using lime?

Witness: Yes, certainly.

The CHAIRMAN: But that the works being near inhabited districts the sanitarian philosophers, as you call them, would object to it?

Witness: They did object, and that was the reason I believe why it was departed from.

The CHAIRMAN: If, therefore, there was a proposal for a new supply at a considerable distance from the inhabited district, the sanitarian philosophers would not object, and we might have the advantage of using lime for the purification of gas.

Witness: Certainly; but I think that a better mode has been discovered than has yet been spoken of, and that is, to continue the use of the oxide of iron for taking out the sulphuretted hydrogen, and then using lime only for taking out the remaining bisulphide. Now that is not an offensive process. By the combination of the two processes, my opinion is that the works can be carried on where they are, but the effect of the double process is to incur a cost of about 10d. per 1000 feet.

The CHAIRMAN: Then the process might be done more simply and more cheaply if new works were established at a distance?

Witness: Yes; but then there would be all the other difficulties which I have had the honour of pointing out, which would be far more serious.

The CHAIRMAN: But I think you have told us that, as regards the leakage, there would be no considerable increase of loss from that cause?

Witness: There would not.

The CHAIRMAN: The difficulty would be in making mains large enough or numerous enough to carry the gas to the places where it was wanted to be.

Witness: No doubt; and the increased depreciation in the quality of the light, by reason of the gas travelling so much further.

The CHAIRMAN: But I think I understood you to say, in the early part of your evidence, that the principal loss was in the first 1000 feet, or something of that kind?

Witness: That depends upon the size of the main. If the main was very large, the 1000 yards would have to be increased of course, because the particles do not come to the surface of the pipe so frequently to rub against it. This depreciation is occasioned by the condensation of the vapours which are held in solution by the permanent gases, and these come into contact with the walls of the pipe, and there they are condensed. The larger the pipe the further the gas has to travel before the same amount of condensation is obtained. But in ordinary cases—for instance, in the case of Nottingham, where we know the facts, because the gas is tested every day at all the stations, and in the centre of the town—we know that in less than three-quarters of a mile we lose, as nearly as may be, 2 candles—1¾ candle; and the further the gas travels, although in a constantly decreasing ratio, and a rapidly decreasing ratio of course, the lower becomes the illuminating power, till at last all the vapours are, so to speak, rubbed out of the gas, and there is nothing but the permanent gases left. You might carry gas so far that it would ultimately burn blue; but that would be a great distance.

The CHAIRMAN: You do not think it would burn blue, I suppose, at such a distance as I suggested to you—a place upon the Thames, for instance, in Gallion's Reach.

Witness: It would not as far as regards the eastern end of the town, but the deterioration at the west end of the town, which is some 15 miles away, I should think would be very serious indeed.

Mr. GOLDNEY: The Western Gas Company supply gas at that end.

Witness: Yes; the Western Company now supply gas at the extreme west end of the town. They supply cannel gas, and I have no hesitation in saying that if that rich gas were to be sent from the place suggested it would lose 4 or 5, or perhaps more candles before it reached this extreme point.

The CHAIRMAN: I forget whether you have given us in detail the calculations of the cost at your works at Nottingham.

Witness: No; I have not.

The CHAIRMAN: What is the cost of your coal per 1000 feet?

Witness: The coal itself is as near as possible 1s. 6d.; not quite 1s. 6d.

The CHAIRMAN: After deducting anything for residual products?

Witness: No; that is the cost of the coal itself. Then we have a deduc-

tion to make for residual products. They amounted last year to a little over £12,000, and that has to be divided by 336 million feet.

Mr. GOLDNEY: You said that the cost of the coal was 1s. 6d., and the net product of gas was 8684 feet.

Witness: Yes. If you want the quantity of gas actually sold at the consumer's meter, that I am now furnishing you with. We sold at the consumers meters 336 million cubic feet of gas, and we got back for our residual products about 8¾d., or a little under that. The cost of the coal is as nearly as possible £22,000.

The CHAIRMAN: We are going to hear Mr. Hope Scott when we meet again. We have heard a great deal incidentally in the course of this inquiry about what the companies consider to be their rights under the legislation of 1860. We shall probably ask Mr. Hope Scott to state to us very distinctly, in the course of his address, what is the construction put by the companies upon the effect of that Statute in regard to their legal and equitable rights.

(To be continued.)

HOUSE OF COMMONS.

METROPOLIS WATER SUPPLY.

SIXTH DAY—THURSDAY, MAY 23.

EAST LONDON WATER-WORKS (VARIOUS POWERS) BILL.

(Continued from page 561.)

Mr. *Charles Greaves* was recalled and further examined: He said that he wished to correct the answer he had given with regard to the estimate for the works D. He had said it was £47,000; it should have been £37,000, and the system of intercepting sewers was carried out on Mr. Bazalgette's plan. He should not think that he would carry away less than 3 million gallons a day.

The CHAIRMAN said that if the River Lea Trustees desired it, they would be heard upon the clauses.

Mr. CLERK stated that he proposed to call Mr. Bateman simply upon the works in the bill, and not upon the general question.

John Frederick Bateman, Esq., examined by Mr. CLERK.

I was requested to consider certain plans on the part of the East London Water Company for getting a better supply of water during last autumn. I therefore put myself in communication with Mr. Greaves, their engineer, and inspected closely all the works in the valley of the Lea. Mr. Greaves explained to me the whole of the circumstances of the existing supply, and I found there was no doubt at all of the pressing necessity for obtaining an additional supply. I inspected narrowly the whole system of pumping and filtering, and all the distributing powers of the company. The matter most pressing was the question of quantity. Mr. Greaves showed the registers of the river in the years 1863, '64, '65, and 1866. They showed the quantity of water which was delivered, the quantity in the river, the quantity in store from time to time, and from those I was able to deduce a history of the company for some years past. I found that the quantity which was being supplied must be stated in round numbers at about 21 million gallons a day now, and that the annual increase for several years past had been at the rate of about 400,000 gallons a day; so that, taking the increase for the future, in ten years from the present time something like 26 million gallons a day would be required for the population within the limits of the company's supply—that is, supposing it to go on increasing in the same ratio which it has done of late years. In the year 1863, the quantity supplied was about 17,500,000 gallons. There was no storeage, and the river was just able to meet the demands; but the whole river was pumped for eight days in July and thirteen in August. In the year 1864 the average consumption remained about the same as it was in 1863, and they had 45 acres of storeage which had been constructed in the meantime. Notwithstanding that they pumped the whole river and the whole storeage, the supply had to be curtailed from 125 million gallons per week, which they were then supplying, and which would have been their full supply, to 105 million gallons. I believe that was during a part of July and August, but I have not the statistics about it. By the year 1866 all the storeage which had been planned by Mr. Greaves was available. In 1865 the demand upon the company and the consumption by the inhabitants had reached 18 million gallons a day on an average, and the whole river was again pumped. There was no surplus for 23 days, but the storeage enabled them to deliver the quantity demanded without curtailing the supply. The whole storeage of 110 acres was not exhausted. At all events it was sufficient to enable them to deliver 18 million gallons a day without lessening the supply. I believe that only 45 acres of storeage were available till 1865, and that the whole storeage was not available till 1866. In the year 1866 they were not pinched for water; there was abundance of rain. They had the whole storeage of those 126 million gallons. In 1864 they were obliged to curtail the supply for three weeks, the river and storeage yielding only 15 million gallons a day from that time, the demand prior to that having been 17,500,000 gallons. 1864 and 1865 were the two driest summers, and the former seems to have been that which most severely punished the East London Company. It is an absolute necessity that they should now get an additional supply in the shortest possible time. If there were such another dry season as 1864 or 1865, or one approaching to either of those seasons, East London would be without water, or at least it must have a diminished supply. You may calculate the 70 million gallons of storeage as being about worth 3 million gallons a day, and if you take the river as yielding, as it did in 1864, only 15 million gallons, that gives you 18 million gallons to meet a demand of 21 millions for about 60 days. In a very dry season that would not give the present demand. In 1854, for some period of the year, it was no more than 15 million gallons a day, and 3 million gallons of storeage added to that would only give 18 millions. I think 19,500,000 is the average of the supply for the whole year. I have considered in what mode the company could best meet the pressing demand. In the river Lea itself there were no means of getting an additional supply of water, except by increased storeage or by sinking into the chalk which lies beneath the London clay, from which some supply of water might be obtained. I am aware that Mr. Greaves has already sunk a well into the chalk at Walthamstow, in the neighbourhood of his works, and only obtained something like half a million of gallons a day. The quantity yielded by any well is a very uncertain thing. Perhaps, generally, wells may be taken to yield about 1 million gallons a day. The wells sunk for the supply of water very generally throughout the country, where they are sunk into water-bearing strata, vary from about half a million to 1½ million gallons each day. The depth of the wells depends upon their position. If you take the new red sandstone of Lancashire and Cheshire, the wells are generally sunk to about 50 or 60 feet below high-water level, and those levels on the average, at Birkenhead and Liverpool, and that neighbourhood, generally yield something like a million gallons of water a day—that is, in the new red sandstone formation. Wells in the chalk formation, in the same way, have yielded their water, no doubt, according to a line running from Watford towards the sea, and the wells towards the sea used to get water at a higher level than those farthest from the sea; but all the wells have become lower and lower, and the level of saturation is much lower than it used to be. I am aware that Mr. Greaves had it in contemplation at that time to increase the capacity of his storeage reservoir at Walthamstow. It is the only course by which you can increase a supply in that valley, and it is the most expeditious course. Those reservoirs are not of difficult construction, and could be commenced at once. They are upon good ground. The embankments are not high, and it is a character of work which may be constructed with facility and rapidity. The place for the new reservoirs appears to be well selected. It is adjoining the existing one. The reservoirs are out of the reach of floods by the height to which the embankments would be carried. The company will then have a storeage of 500 million gallons, the greater portion of which will be able to pass to the existing filtering-beds without pumping, within 50 million gallons, I believe. The original reservoir of 110 acres is of the capacity of 220 million gallons, of which 170 million gallons run off, and 50 million gallons require to be pumped. It would give an additional supply of about 5 million gallons a day for 100 days to the natural supply of the river. There was a proposition for increasing the filtering area at Lea Bridge. That would not increase the quantity of water; it would merely increase the facility of filtering it. A large filtering area would merely enable the company to give the water in a very pure condition; but their filtering arrangements are at present very extensive and very good, and it would merely require an extension of the filtering area coextensive with the additional supply proposed to be given. My attention has been drawn to the proposal of Mr. Greaves to extend the intercepting drains which had been constructed in 1853. I am aware that since that Mr. Bazalgette has reported against these as being insufficient in themselves, and that the Royal Commission has reported in favour of a large general system of drainage of the Lea valley, and that, therefore, these have been struck out of the bill. I recommended the company to apply to Parliament for getting a supply from the Thames. I am aware, from what is proposed by Mr. Greaves, that all objections to the use of the covered reservoir at Old Ford will be got rid of. I think Mr. Greaves is proposing more than is necessary there, but it will be satisfactory, I dare say, to other people. I do not say that it is not necessary effectually to prevent any leakage or percolation from the external earth into the reservoir, but I think that in proposing to fill it up, as he is proposing to do, he is doing more than is necessary. By shutting off that part of the reservoir which is in gravel, and raising the floor of the clay reservoir by 4 feet, and puddling it all round, it will prevent the slightest possibility of filtration if the work be properly performed. It is necessary to have a small reservoir of that kind for the purpose of feeding the pumps which are in operation at Old Ford. The whole quantity of water held by those two reservoirs is only 3 million gallons, I think, now; and, therefore, there is only one-sixth or one-seventh of the quantity of supply in a day—two or three hours supply. The Lea water is well filtered by the East London Water-Works, and is of as good a quality for domestic use as the Thames water. There is very little difference in the quality.

Mr. CLERK: And supposing the recommendations of the Rivers Pollution Commissioners to be carried out, so that there shall be legislation for the Lea similar to that for the Thames of last year, will the water of the Lea be superior to that of the Thames?

Witness: It will be still, I think, pretty nearly equal to that of the Thames, because it will have to go through the same system of purification.

Cross-examined by Mr. JOHNSON: I understand that Mr. Greaves wants to have the entire command of the water at Chingford Mill and of the mill too. The power which he would obtain under this Act would totally incapacitate the working of the mill, if he had full power to deal with that mill and with the water.

The CHAIRMAN said that the committee quite understood that the water-works company would have power to take the water without reference to the requirements of the mill.

Witness: I think the fall at the mill is about 7 feet, and then Mr. Greaves would take it from the mill-head, and that would give him 7 feet advantage over taking it from the tail. The flood waters are of no use to the mill. The flood water which was not required for driving the mill might be conveyed by the channel into the reservoir which he is proposing to construct. Then any water below the level of the flood water might be taken into the reservoir by artificial means. There would be 2500 cubic feet a minute, and, in round numbers, 20 millions gallons a day. That would require about 40-horse power, and the expense would be from £800 to £1000 a year, pumping constantly night and day.

The CHAIRMAN: What is the horse power of 1 mile?

Witness: It is 2500 feet per minute, supposing that that was always in the river, which is the whole quantity supposed to be in the river, though it is not always that. The horse power is about 21-horse power, and that would cost, working both night and day, about £500 a year. It is quite practicable so to adjust matters as to provide steam power just proportionate to the water power which is withdrawn. The mill is a very good one.

Re-examined by Mr. CLERK: This is wholly a question of compensation. Any arbitrator would have to take into consideration what rights the tenant has in the water, or how much he has already been paid for it.

By Mr. HEADLAM: Of course, mechanical filtration through sand will not deprive the water of any impurity which it may hold in solution, but all mechanical impurities are taken out by filtration through sand. There is no doubt that water possesses in itself a self-purifying property, and that which may be very bad higher up becomes very tolerable lower down. The state in which it is before it passes through those filtering-beds depends very much indeed upon the weather. In extremely fine dry weather the water will be bright, and apparently to the eye it will be pure, or tolerably so, even as it comes out of the river; but in wet weather it will be more or less turbid, according to the quantity of rain which has fallen. In its ordinary state, immediately above the filtering-beds, it is generally like all chalk water—it is a bright transparent water—a white water. When it is unaffected by rain, which carries anything from the claycy surface of the lower portion of the district, or from any of the upper portions of the valley, the water will be bright and clear, and you can see through it for some distance—10 or 12 inches—without any difficulty, and sometimes more.

Mr. LOVELL: Is there any appearance of great pollution in the state of the river immediately previous to the time that it passes into the filtering-beds?

Witness: Not in fine weather; but, of course, all rivers which derive a large portion of their supplies from surface water or rains will be coloured whenever it rains, and will be more or less coloured, according to the use made of it, in all weather; but, generally speaking, this will be a bright river comparatively. In fine weather (when the river is low), though it may appear free from soil and impurities of that description, there will be

a greater quantity of impurities cast into the river. But they may not be present in flowing water; they may be deposited, more or less, within a short distance of where they are thrown in, and not sent to any distance till a flood comes, and then they will be carried down. That water would be better after those storeage reservoirs were made. All water which is collected in a comparatively impure or turbid state improves by settlement, which it will be able to get by those large storeage reservoirs. I cannot say whether the company will take their 18 million gallons direct from the river, and then take 4 million from the storeage, or will they take the whole from the storeage, letting the 18 million replace the quantity which they take out, inasmuch as I have not the working of the undertaking, but it will be quite easy for them to take the whole of the water first into store; supposing they were to purchase this Chingford Mill, so that they had no occasion to let any portion of that water be used for driving the mill, they could take the whole of the river into their storeage reservoir, and let it deposit there, and then take it from there to the point where it is distributed. No doubt that would be a better course than to take it direct from the river.

By Mr. BENYON: I am aware there is an arrangement between the New River Company and the East London Company by which the quantity of water which comes down is divided between them. When I speak of the river as being pumped dry, I mean that every drop of water is pumped out of the river by the East London Company at the point where they take it; as far as regards the river absolutely. The river is divided at Hertford in this way. At Hertford, which is 30 or 40 miles up, the New River takes its supply, and the river is supposed to yield beyond what is required for navigation an equal quantity in its course from that point down to the place at which the East London Company take their water, and at that point, if they require the whole of the river, they take it. The New River takes its supply just below Hertford and above Ware, and above the place where the discharge of the sewage of Hertford is made into the river. The supply of the New River is above the discharge place of the sewage of Hertford. When I am talking of storeage, I mean that the present storeage will give them 3 million gallons, and the storeage which they are proposing to add to it would enable them to give 5 million gallons for store. The flood water will give them all the water which is required for filling these reservoirs.

Lord F. CAVENDISH: We have been informed by Mr. Greaves that a complete system of intercepting sewers, so as to keep the water pure, would cut off about 3 million gallons daily; if that diminished the supply, would the proposed new works provide an adequate supply in your opinion?

Witness: I think that Mr. Greaves could hardly say that would cut off 3 million gallons in dry weather; it must have been the average stream. Certainly the intercepting drains proposed by him would not diminish the available volume by 3 million gallons.

Mr. CLERK: Mr. Greaves said that, if Mr. Bazalgette's scheme were carried out, the volume of the river, in its ordinary state, would be diminished by 3 million gallons.

By the COMMITTEE: As to the quantity of water which Mr. Bazalgette's proposed drainage scheme would abstract, I have not considered it, but I think that it is very likely, and, taking the average of years, that would be the result which Mr. Greaves stated; but I have not considered it, and therefore I cannot give a precise answer. I have not read the report of the commissioners on the best means of preventing the pollution of the river Lea. I have read the recommendations and conclusions. They recommend an extensive series of works, to prevent the pollution of the river. Whether, if such a system were carried out, the river Lea and the proposed new works would provide an adequate supply for the wants of the East London district, would depend upon the amount of storeage required. My own opinion is that it is quite evident that the river Lea is not sufficient for the supply of the district within the East London area. As it is with the proposed new works, it is only just equivalent to the demands upon them, or which will be made upon them in a very short time. If any material diminution of the supply were to take place by the drainage works proposed, the East London Company could only be put in the same position as they stand in now as to quantity by increased storeage. There is abundance of water for a much more greatly increased storeage than that which they propose, but of course it is a very expensive thing to make storeage reservoirs of any considerable size in a valley like that of the Lea. No doubt in the wet season there is abundance of water to fill any reservoir that is proposed. I do not go so far as to say that filtration through gravel and sand has no effect in purifying polluted water from matter held in solution. It has a considerable effect; it very materially improves water mechanically and chemically, but it does not deprive water of chemical ingredients. It entirely removes organic impurities, except those which are held in solution. The intercepting drains may be so constructed as not to take any water except that which they are intended to take—namely, the foul water; but they are seldom so constructed, because, although the culverts themselves may be made so water-tight as not to allow water to escape outwards or to allow it to come inwards, yet the excavation being made very much in the gravel, forms a natural drain on the outside of the new works, and therefore, unless they put stops to prevent the water passing through, a great quantity of the land water is discharged. In speaking of the quantity of water that may come into the reservoirs, I have taken into account the right of the New River Company to draw the water. They are entitled to take *pari passu* 500 feet a minute below that point, but there will be an abundance of flood water after the abstraction of it. The floods are more than twice sufficient to fill those reservoirs; they are more than four, or five, or six, or perhaps more than ten times sufficient; therefore both parties, in the ordinary way of taking water from the river, would be entitled to take the water in the way in which it is now arranged. The flood water cannot be taken by storeage by either of them.

Mr. CLERK stated that under the Act of 1855 each of the two companies was entitled to take 22,500,000 gallons a day, and that that quantity could not be obtained from the river in times of great drought.

The CHAIRMAN stated that if the bill was passed it would be competent to the New River Company to make reservoirs, and upon giving notice to draw into their reservoirs as much as the East London Company draw into theirs, so that the legal right of the East London Company was to take one-half of the surplus water.

Henry Letheby, Esq., M.B., examined by Mr. CLERK.

I am the professor of chemistry in the Medical College of the London Hospital, and also the medical officer of health and chemical analyst to the City of London, and I have had considerable experience in analyzing and studying the chemical composition af water, not only in London, but in different towns in England. I have frequently been called upon to make examinations of water both for parliamentary committees, for local boards, and also for the corporation of London. I have been engaged in that matter very much for the last 20 years. For many years past I have had to examine monthly the water supplied to the metropolis by all the companies, the result of which has been regularly published by the Metropolitan Association of Medical Officers of Health. I am well acquainted with the quality of the East London water. It is supplied to our laboratory at the London Hospital. With very rare exceptions it is delivered to us bright and colourless from the mains. Now and then it is a little turbid, but not often. There have been occasions when there have been heavy floods in the river, but nearly the whole of the water in the metropolis I may say has been a little turbid. I have here a table showing the average composition of the East London water for each of the last six years.

Average Composition of the East London Water in each of the last Six Years.

I.—Taken from the Reservoir at Lea Bridge.

Constituents per Gallon.	1862. Grs.	1863. Grs.	1864. Grs.	1865. Grs.	1866. Grs.	1867. Grs.	Aver. Grs.
Carbonate of lime and magnesia	13·75	13·12	12·00	11·97	13·02	13·39	12·88
Sulphate of lime	3·52	2·93	3·29	2·97	3·57	3·46	3·29
Chloride of sodium	1·69	1·78	2·00	1·74	1·65	1·43	1·73
Alkaline nitrate	1·81	1·63	1·37	1·15	1·07	1·63	1·44
Silica, alumina, and oxide of iron	0·77	0·92	0·70	0·72	0·49	0·46	0·68
Organic and other volatile matter	1·08	1·28	0·82	0·48	1·21	1·15	1·00
Total solid matter per gallon	22·62	21·66	20·18	19·03	21·01	21·52	21·02

II.—Taken from the Main at the London Hospital.

Constituents per Gallon.	1862. Grs.	1863. Grs.	1864. Grs.	1865. Grs.	1866. Grs.	1867. Grs.	Aver. Grs.
Carbonate of lime and magnesia	13·38	12·77	11·98	11·90	12·77	13·08	12·66
Sulphate of lime	3·41	2·88	3·39	2·89	3·49	3·53	3·23
Chloride of sodium	1·70	1·76	2·04	1·74	1·56	1·36	1·69
Alkaline nitrate	1·64	1·59	1·28	1·08	1·23	1·57	1·40
Silica, alumina, and oxide of iron	0·74	0·88	0·62	0·75	0·49	0·47	0·66
Organic and other volatile matter	1·11	1·27	0·84	0·54	1·12	1·06	0·99
Total solid matter per gallon	21·98	21·15	20·15	18·90	20·66	20·87	20·63

I have had samples from the reservoir at Lea bridge, and I have taken samples myself from the London main. I have compared them every month during the last six years. The water, as delivered in the hospital main, is in a purer condition than that which I took from the Lea Bridge reservoir? That is the case with water supplied by every one of the London companies. The water, in the act of passing along the mains, loses a certain portion of organic matter, and also a certain portion of carbonate of lime, and therefore the water which I get from the public mains is always a little better in quality than that which I get at the reservoirs of every one of the companies.

By the CHAIRMAN: No doubt running water does purify itself. This water is well aërated, and contains so large a proportion of atmospheric air, and especially of atmospheric oxygen, that it is very much purified, though it is in closed pipes. It is a proof of aëration when we find that oxidation takes place in a closed pipe.

By Mr. CLERK: I regard the East London water as a very good water for domestic consumption. There is nothing whatsoever, as far as chemical evidence or chemical analysis can go, to discover anything at all in it which renders it unfit for public use. The quantity of organic matter is small. It amounted, upon the average, to one grain in the gallon in the water from the reservoir; and in the water from the main it amounts to about ·99 of a grain; but that represents more than the organic matter; it represents other things which are driven off by the process which we call incineration, or the application of heat; and I may say, relying upon the test of permanganate of potash, not one-half of that is organic matter. There is no absolute process known to chemists which will expose the actual quantity and real proportion of organic matter in water. We are obliged to rely upon two processes—one is called the process of incineration, and the other is the permanganate of potash. I took both of them. In the incineration process you evaporate all the water and examine the residuum; and if the residuum is not perfectly dried by the process of submitting it to red heat, water will go off, and that is put down as organic matter. I use that test in the first instance. I also submitted some of the water to the other test by means of permanganate of potash. I am alone in that mode of estimating the quantity of organic matter; but in determining the relative proportions I am not alone. I believe that every chemist, who has had any large experience in the analysis of water, relies almost entirely upon the permanganate of potash test as evidence of the relative proportion of organic matter. I go a little further and rely upon my experience in making it evidence of the absolute proportion, but I stand alone in that respect. I have obtained an empirical standard founded entirely upon my own experience. As far as I know, every water analyst in England but one agrees with me that permanganate of potash is a good test of the relative quantity of organic matter in water. Dr. Frankland does not agree with me. I can make an experiment, if it is at all a matter of interest to the committee to see how the experiment is made. To-morrow I am to endeavour to satisfy Captain Tyler that I took a correct view of this matter. I do not believe there is any real difference in our mode of investigation up to certain points, and then comes the question as to whether that empirical formula is the right one. I stated that the organic matter, as appearing in this table, is not large for any domestic water. It has been determined by incineration only, and it represents therefore the maximum, or, as I call it, the exaggerated proportion. Unless waters are derived from wells near to the seashore, the chloride of sodium, or common salt, which is a very large constituent of sewage and of urine, is always a very good exponent of the quality of the water. The quantity of chloride of sodium per gallon is small. It is below the average of the water supplied to towns and of the running rivers of England. It amounts only to 2 grains in one case, and 1·7 grain is about the average proportion of it. I have examined the water of the company at Old Ford, Lea Bridge, and at Walthamstow repeatedly, and I have traced the course of the river from the works at Higham Hill to Hertford and to Bishop's Stortford. Those works seem to be well adapted for the purpose of purifying the water. In the first place they have a very large storeage or subsiding reservoir at Walthamstow, and, as I am informed and believe from the area of them, they hold nine days water. Therefore there is nine days aëration of the water and subsidence, whereby all or most of the organic impurities of the water will subside, and then there is a run of about 1¼ mile to Lea Bridge, where the water undergoes filtration through sand filters. I have seen those filters in operation, and they are constructed in accordance with the most approved plans, and they filter the water very well. It is not the case that filtering through a well-constructed sand filter only removes the impurities which are held in suspension in the water. The suspended impurities rest upon the top of the filter, but we

know that the water in traversing the sand loses a portion of its carbonate of lime, and the sand possesses the power of causing a more rapid oxidation of the organic matter than would take place otherwise. The water, therefore, flowing out of a sand filter is always less charged with total solid matter, and less charged with organic matter going into the filter, quite irrespective of that which is merely floating on the surface. I have a table which shows the condition of all the London water before and after filtration, and there is no doubt of the removal of it. I have made the experiment so often that I have no doubt about it. I have examined the comparative purity of the water at Lea Bridge and at the hospital main, and ascertained that there is no impurity coming into the water after it has been filtered at Lea Bridge. The water has improved, and not deteriorated in quality, and therefore I say that nothing can have come into it of any moment from the time of its delivery into the main. I was present, I believe, at Old Ford on the 24th of February, when the covered reservoirs were emptied at the request of Captain Tyler. I have a sample taken from the reservoir at the end of the pumping operation, when it had been brought down as low as possible. There is no organic matter in it. There was some water found spurting on one side of the covered reservoir, which I analyzed. The results are given in the following table:—

Composition of the Samples of Water from the East London Reservoirs, at Old Ford, after the Pumping Operations had been completed, and of Water spurting from the sides and slopes of the Reservoir.

	Water from Reservoir at end Pumping Operation.	Water spurting from Wall of Reservoir.	Water spurting from Slope at North End.	Sample taken from Hosp. Main in Feb.
Date of Sample, Feb. 24, 1867.				
Total solid matter per gal. (grs.)	22·5	30·0	24·9	22·75
Of which organic matter and other matter lost by incineration (grs.)	3·3	3·4	2·5	2·5
Organic matter, as estimated by amount of oxygen required to oxidize (grs.)	1·28	1·12	0·56	0·80
Hardness before boiling (deg.)	14·5	16·5	15·5	13·5
Ditto after ditto („)	4·0	8·5	5·0	5·0

I have also a table which shows the average composition of the water in each of the months for the last six years. The object is to ascertain whether or not there is any great variation in the quality of the water from month to month. That gives the average composition of the water in each of the last six years.

	Carbonate of Lime and Magnesia.	Sulphate of Lime.	Alkaline Chloride.	Alkaline Nitrate.	Silica, Alumina, and Oxide of Iron.	Organic, and other Volatile Matter.	Total Solid Matter per Gal.
	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.
January	13·5	3·9	1·8	2·6	0·9	0·7	23·4
February	13·4	3·8	1·7	1·5	0·8	0·9	22·1
March	13·2	3·8	1·7	1·8	0·7	0·9	22·1
April	13·3	3·3	1·7	1·4	0·6	0·9	21·2
May	12·2	2·7	1·6	1·6	0·6	0·8	19·5
June	11·9	2·6	1·6	1·1	0·6	0·7	18·5
July	11·6	2·4	1·6	0·7	0·6	0·7	17·6
August	11·2	2·7	1·7	0·7	0·5	0·7	17·5
September	12·2	2·6	1·6	0·9	0·6	0·6	18·5
October	12·3	3·2	1·7	1·1	0·7	0·8	19·8
November	13·7	3·4	1·7	1·9	0·7	1·0	22·4
December	13·3	4·1	1·9	2·1	0·8	1·2	23·4
Average	12·6	3·2	1·7	1·4	0·7	0·9	20·5

This table proves that there is always the greatest quantity of solid matter per gallon of water during the wet months of the year; and that is so with regard, I believe, to every river in the kingdom. The organic and other volatile matter do not vary so much, but that is true, to some extent, of the organic matter. The organic matter is the thing to be looked to chiefly for real impurity; in November and December that is greater than in any other times of the year. The floods in the autumn sweep the surface of the land after everything has withered and decayed which has been growing on the surface, and another reason why we find the organic matter to be larger in quantity in the winter months than the summer months is that the process of oxidation and decomposition is not going on in the cold weather, and, therefore, there is more of that in the winter than in the summer time. Here is a table giving the composition of the East London water during the cholera period of last year, or from April to December.

1866.	Carbonate of Lime and Magnesia.	Earthy Sulphate.	Alkaline Chloride.	Alkaline Nitrate.	Silica, Alumina, and Oxide of Iron.	Oxidizable Organic Matter.	Total Solid Matter per Gal.
	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.
April	13·51	3·40	1·31	2·61	0·40	0·37	21·60
May	13·10	2·79	1·50	3·60	0·31	0·38	21·68
June	11·18	2·02	1·09	2·62	0·46	0·33	17·70
July	12·00	2·42	1·32	1·52	0·50	0·40	18·16
August	11·51	3·05	1·52	1·28	0·27	0·56	18·19
September	13·05	2·52	1·27	0·86	0·43	0·39	18·52
October	10·17	3·39	1·58	2·29	0·58	0·68	18·69
November	14·98	2·97	1·01	1·99	0·42	0·72	22·09
December	14·24	4·16	1·42	1·97	0·50	1·16	23·49
Average	12·64	2·97	1·34	2·08	0·43	0·55	20·01

This is a sample that was taken at the hospital main during the whole of that time, and as delivered to the public. The organic matter here is ascertained by incineration in the same way. The oxidizable organic matter I determined by the permanganate of potash. During all that time I found that the water of the East London Company still maintained its character as a good water for domestic use. I could not by chemical means discover that there was anything in that water of an objectionable quality. At that time I was making more than two analyses a month, because I had a good deal of anxiety on the question, an opinion being spread that the cholera might be attributed, to some extent, to the East London Company's water, and, as that company supplied the City of London, I felt it to be my duty to look into that matter. I found that during all that period the East London water was as good as its average quality. It was a good water.

Mr. CLERK: You are aware, no doubt, that a great deal of sewage is discharged from different towns on the banks of the river Lea, and of the Stort, one of its tributaries, into the river. In the passage of the water down the river for a distance, say, of 20 or 25 miles, does a very large proportion of the sewage matter discharged into the river become oxidized?

Witness: That is so; and I may remark that with many, if not most of the rivers of England, after a run of 18 or 20 miles, or even less than that, it is not possible to discover by chemical means a trace of sewage in the water. For instance, between Coventry and Warwick, all the sewage is discharged into the river, and at Warwick they are taking it for the town supply, and at the time that I examined it I could not by any chemical analysis find a trace of sewage in the water. The heavier matters very rapidly subside; in the next place, the matters are capable of undergoing oxidation are eaten by the fish, and plants are very greedy in taking up all that is in solution; and then there comes the power of atmospheric oxidation; so that, between all those operating circumstances, the sewage is quickly gone. The distance from Coventry to Warwick is, I think, about 9 or 10 miles.

Mr. CLERK: But great as the oxidizing power of the air is upon running water, you still would doubtless recommend the adoption of such a scheme as that proposed by the Rivers Pollution Commission?

Witness: There is no doubt, although the power of oxidization and self-purification are very great in respect of running water, it is highly necessary that the rivers of this country should be kept free from sewage.

Mr. CLERK: Under such a scheme carried out as that suggested, and as is being done to the Thames under the Act of 1866, would the river Lea become a first-class water?

Witness: I should think so. At the present time you cannot discover the sewage in a run of 20 miles from Bishop's Stortford, where the river is so foul as really to alarm one. I was told by the man at the mill a mile and a half below Bishop's Stortford, that he could hardly live there in summer time, and yet in a run of 20 miles the sewage cannot be discovered by chemical analysis.

Mr. HENRY BAILLIE: How is it at the junction with the river?

Witness: Not very bad; it mixes with a large body five times, I should think, its bulk, the Stort water being about one-fifth that of the Lea, and then it is not bad. It has undergone a great change between Bishop's Stortford and the outfall before it runs into the Lea.

Colonel HOGG: Do you not think that such water must contain deleterious matter, although chemically you cannot find it out?

Witness: I think that does not necessarily follow. We do not at the present moment understand the immediate agents of disease. In all probability they are living germs. It is quite possible, though it is not probable, that a living germ might live in the water when other things would go, and those minute germs are not discoverable by the microscope, or by any chemical process, therefore it is just possible, though there is no evidence at the present time of the probability. This water has been used for a great many years in the London Hospital, ever since I have known the hospital, and that is pretty nearly a quarter of a century. It was used during the whole of the cholera time, when the hospital was full of cholera patients, and when there were nearly 900 patients in the hospital, and there was not a single instance of cholera in the hospital except those who were brought in as affected by the disease. There were, I think, about 487 persons residing in the hospital, excluding the cholera patients, and they were all taking the water exactly as it is delivered from the main, without any filtering process whatever, and not a single instance of cholera occurred. I have gone into the matter very carefully, and my belief is that there was no connexion between the Old Ford reservoir or the water delivered by the East London Company and the cholera in London. I found that in the eastern part of London there was only a single house of all the houses supplied by the East London Water Company where the cholera was. It was in the houses supplied by the New River Company. I was asked to examine the Temple water, but I was away; it was examined, I think, by Dr. Norel. That is not New River water, it is pump water. The East London water district does not extend to the Temple, it only takes the eastern boundary of the eastern part of the City. I may say that altogether there were 103 cholera deaths in the City during the epidemic, and in the eastern division of the City there were 62 deaths, and there was only one house (and in that house, which was in Somerset Street, there were two deaths) out of all those in which the East London Company's water was taken; all the others were supplied by a company whose water has never been attacked on the score of purity—the New River Company. Then, again, there are two workhouses which belong to the City, and about which I receive every week details in respect of the progress of the cholera. One of those workhouses is the City of London Workhouse, situate at Bromley, in the Bow Road, where they did not take a drop of East London water, and there they were decimated in one week by cholera; they were supplied from a draw-well. The other workhouse is the West London Workhouse, at Hackney; they did take the East London water, and they had not a death. The only houses in London where we know, as far as my inquiries have gone, that the Old Ford water was given were at Stamford Hill and Clapton, and they had no deaths from cholera. Those were the only houses where beyond all doubt that water was taken. There was another point which struck my attention, and into which I went very much, with respect to the possible connexion of the cholera with the water. I found that there was no relation whatever between the time of the outbreak and the distribution of the water. Assuming for a moment that the water supplied by the East London Company contained the poison germ—it might be arsenic, for example, or alcohol, in the place of cholera—distributed over the district, there would be something like uniformity in the outbreak of the disease; but a month elapsed between the date of the appearance of the disease in one part of the district and another. There was no connexion of time, so to speak, between the distribution and the outbreak, nor in the culminating of the disease. I have taken them week by week throughout the whole time of the cholera, and I find no connexion either in the time of the outbreak or in the duration of the disease, or in the time of the intensity of the disease.

Mr. CLERK: Was the proportion of deaths per 1000 or 10,000 men greater in districts not supplied by the East London Company than in districts which were so supplied?

Witness: Yes; in Whitechapel, in the City of London, and about the western division, where the cholera existed in many of the streets. In the streets where the New River water only was taken the mortality was greater than in the next street, where the East London water was taken; the localities were under much the same condition with regard to crowding and as to the character of the inhabitants. In the whole district of Whitechapel, the mortality from cholera, according to Mr. Liddell, who is the medical officer of that district, was 32·5 per 10,000 of the inhabitants; whereas, in a yard called Blue Anchor Yard, which is supplied with New River water only, the mortality was 144·9 per 10,000 during nearly the whole of the epidemic.

Mr. CLERK: Did you find from inquiry, and from the reports of the medical officers of the different districts, that the mortality was much less among the water-drinkers—that is, the abstinence people?

Witness: Yes. I hold in my hand a report of the medical officer of the Limehouse district, where the cholera was very bad. He, like myself, went very much into the water question, and he thought that if water was the cause of cholera, he should find it among teetotallers, but he found the mortality much less among them. The proportion was larger among gin-drinkers, and I find also during the whole period of the epidemic, the mortality was larger on Tuesday, which would seem to indicate that the excesses of Saturday had laid them open to the cholera, and they died on Tuesday. That coincides with the history of cholera in India, where people

get the cholera after they have been drinking and indulging in excesses, and I think that is the tendency everywhere.

Mr. CLERK: Did you observe circumstances in your examinations which would account for the prevalence of cholera in those East London districts, independently of any question of water supply?

Witness: Yes. East London is a peculiarly low-lying district. At every visitation in London it has been found that the higher level districts have suffered less from cholera than the low-level districts. If you were to compare, for example, Stamford Hill, which is supplied by Old Ford, and Clapton and Haggerstone, and those high elevations, with the middle districts of Hackney and so on, and Bethnal Green, it would be found that there had been less mortality (in fact, there was none at all at Stamford Hill and Clapton) than in the middle districts, and less in the middle districts than in the low ones. All those elevations are above Trinity high-water mark, and therefore I say that though the fact of the East London Company supplying the low-lying districts is coincident with the fact that the cholera decimated those districts, much, and more, must be said as to its being dependent upon the fact of the district being low-lying as upon anything else. Then again, those districts are districts where we know that the poor are overcrowded, and that there is probably more poverty and dissipation, and everything which can tend to aggravate a disease than in other districts in which we found it to be less severe. It was also the district where the drainage works were in the least favourable condition.

Mr. CLERK: I think that at page 7 in the return there is this statement:—"In reply to an inquiry, Mr. Bazalgette has favoured the Registrar-General with a short account of the drainage of the cholera district. It is unfortunately just the locality where our main drainage works are not complete. The low-level sewer is constructed through the locality, but the pumping-station at Abbey Mills will not be completed until next summer. Therefore the drainage of the district does not flow into the low-level sewer. We are deodorizing the sewers and gullies freely with chloride of lime, and to-morrow I shall recommend the board to erect a temporary pumping-station at Abbey Mills, to lift the sewage of this district into the northern outfall sewer. This can be accomplished in about three weeks time." That was in the month of August, after the cholera had culminated, was it not?

Witness: The cholera in London was, for the most part, severe in the weeks ending the 4th and 11th of August; therefore, this plan of pumping must have been complete in about three weeks time from the date of that letter, which would be somewhere about the end of August.

Mr. CLERK: Did you find the cholera prevailing more extensively in streets, according to their position with reference to the points of the compass?

Witness: Yes. I have had that inquired into. I was anxious to know whether or not the drainage of the locality, or the circulation of the air in the locality and in the streets that were in the direction of the prevailing wind, affected the question, and whether we should find less cholera in them than on other occasions, because we were quite in the dark as to the cause of the intensity of the disease in that quarter of London; and I found, upon looking at them upon the map, that nearly all the streets, or by very far the largest propertion of them, in which the cholera was most severe, ran east and west, and the winds at that time were not in that direction. They would seem, therefore, not to be well ventilated.

Mr. CRIPPS: You say that you have not traced any direct connexion between the water supply of East London and the cholera, but you would think it very probable, would you not, as a general proposition, that cholera or any epidemic disease of that kind, might be increased if the water was in any way impure.

Witness: I have no doubt that may be and has been propagated by water, particularly with regard to our surface wells, and that might be established also with regard to a public water supply; but I have no doubt that water may be the means of propagating cholera. During the present epidemic I have myself been able to trace cholera to wells. There was a remarkable case at Gravesend, where the water smelt on a Sunday, and the people were attacked on the Monday and Tuesday. I had to analyze the water there, and I have no doubt that the water was the cause of the cholera there. It would make a great deal of difference how the party who used the water was fed or clothed or cared for, as to whether the water would have a bad effect upon him or not; all those circumstances which tend to decrease the vital power—as, for example, dissipation, want of food, want of rest, or a general poverty of the system from any cause whatever—will render an individual more susceptible of the disease than a stronger man.

Mr. CRIPPS: I imagine that, with reference to the persons employed by you generally in the East London Hospital, they were well cared for, so as to render them as little susceptible to cholera as possible?

Witness: Yes; but many of the patients might be said to be in a condition liable to it, from being prostrated.

Mr. CRIPPS: But you would not for that reason infer because parties at the London Hospital—such as nurses and persons of that kind—did not take cholera, that they might have been drinking something which might have aided cholera under less fortunate circumstances?

Witness: Certainly not. If I had only that fact to go by I should not think much of it; but I put a large number of circumstances together, and upon them I base my conclusions. A large number of the persons supplied by the East London Water-Works are persons of a very poor condition of life, suffering privations of many kinds, and perhaps with insufficient food, and so far predisposed to take cholera if they took water in which there was anything at all deleterious. The filtration of the water removes some of the organic impurities of the water, a portion of that which is in solution as well as that which is suspended; 3 feet of sand will not remove all. Chemical analysis enables us to detect certain chemical properties of water, but, in reference to organic impurities, we are not able to ascertain whether there may be in that water what may be called choleraic matter. There are no absolute means, either microscopical or chemical, to enable us to discover the nature of the organic matter which is held in solution. We cannot discover animalculæ in water by a chemical process, but by a microscopical process we can do so.

Mr. CRIPPS: Dr. Frankland, speaking of the organic matter in the water, says this—"The above results show that, in this respect, the water supplied on the 1st of August is considerably better than that supplied on the 1st of July, when the amount of this ingredient was markedly above the average chemical analysis; therefore, although it shows a larger quantity of organic matter than ought to be contained in water used for drinking purposes, it does not reveal any exceptional degree of pollution in this water. It must be borne in mind, however, that chemical investigation is utterly unable to detect the presence of choleraic poison amongst the organic impurities of water, and there can be no doubt that this poison may be present in quantity fatal to the consumer, though far too minute to be detected by the most delicate chemical research." You would assent to that, would you not?

Witness: That is rather strongly put, but as a general proposition it is correct enough. I should think that if the poison were present in a quantity to be fatal to the consumer, the chemist would be able to detect it; but it may be there in sufficient quantity to be injurious.

The CHAIRMAN: How can he detect it if is not there?

Witness: The question arises thus: the chemist cannot discover choleraic poison, the chemist supposes it to be there, and he cannot discover it. There is no test to apply to discover its presence; it might be there and we could not detect it. If we are to use the water of a river for drinking purposes, I do not think it a desirable or proper thing that the rivers should be, notwithstanding their self-purifying powers, the receptacles of sewage. I have said it was possible that deleterious matter may remain in water which has been polluted by sewage, although it cannot be discovered chemically; but it does not appear to me that it is very probable, because it is only assuming one condition of things of which we know nothing, and that is, that the agent of these special zymotic diseases, as they are termed, is a living thing. If those diseases are brought about by the action of putrifying matter on the human body, then I say that the putrifying matter cannot exist in running water for any distance; but if you assume that it is a living germ, then I say that it is possible that it may be in the water without being discovered. The water of the Lea is very much polluted, especially at Bishop's Stortford, at least the Stort is polluted very much. Bishop's Stortford is a very flourishing town, and one which I should think is likely to be flourishing. The river is in a frightful state there; it is desirable to devise something to protect the river from the increased sewage which is likely to flow into it from increased population as well as from what already exists.

Re-examined by Mr. CLERK: When I analyzed this well water at Gravesend there was a very large amount of deleterious matter found in the water. At the beginning, when it was warmed, it had a distinct odour of sewage, and when it was analyzed the presence of sewage was unquestionable. The feeling that all people have, and very naturally, renders it very desirable that the sewage should be kept out of the water, although we may carry that notion a great deal too far, and say, with respect to the fruit we eat, that it probably has had its origin in sewage or some such thing as that. With regard to the condition of the people in the east of London, I have given already certain cases where the cholera was more rife in districts not supplied by the East London Company, but in districts supplied by another company. The inhabitants of the houses supplied by the East London Water Company were not a bit better than those living in houses supplied by the New River Company. Notwithstanding this, those who were supplied by the New River Company suffered much more than those who were supplied by the East London Company. I should think, as a rule, the poorer classes and the most feeble individuals of this district are generally gin-drinkers; they are not great consumers of water.

Mr. KEKEWICH: Is it not now an acknowledged fact that the infection of cholera is propagated chiefly by the discharges?

Witness: That is now, I think, a very well established fact. I do not think that it is propagated in any other way. Of course, all those diseases must have an origin, and there may be spontaneous origin of them. Small-pox and other diseases are undoubtedly communicable by means of matter which we can take from one patient and give to another; but, as a rule, as in the case of small-pox, the matter discharged from the pustules of the body is the medium of communication, and the real agent of the disease; and so I think, in cholera, the matter discharged from the body is the real agent of disease. I should conclude, therefore, that cholera is more likely to spread where water is drunk with sewage in it, whether it be well water or river water, provided that sewage has only recently entered it. We do not know at the present time how long the discharges from the body may retain their morbific action—they may lose that action in the course of a week for aught we know; but that matter discharged into a well of water, or into a running stream, and taken a short time after the discharge, may cause disease before it is diluted, or even after dilution.

Mr. KEKEWICH: You have seen the 35th page in this report, in which there is a pretty strong inference drawn that the spread of the cholera in the lower district of London was owing to the supply of the East London Water Company. There is a comparison drawn between the districts supplied by the New River Company and those supplied by the East London Water Company in favour of the New River Company as against the East London Company.

Witness: I might make an exact comparison of a similar kind. I might say there are two gas companies supplying the East-end of London, and it is a remarkable fact that in the district supplied by the Commercial Company cholera has existed, and in another district, supplied by the City of London Company, the cholera has not existed. There is just the same amount of coincidence and parallelism between these two cases as between the water companies. I have no doubt that the great prevalence of cholera in these districts is owing to the low position of the neighbourhood, and also probably to the manner of living and the dirty habits of the inhabitants. I have noticed in my own district in the East-end of London that when the cholera appears in a poor house it goes further in that house, owing to the dirty habits of the people, who may let some of the matter get into contact with their hands, and so it spreads.

Colonel HOGG: With regard to that letter of Mr. Bazalgette's, did you find a decrease of cholera after the erection of the new station at Abbey Pumping Mills?

Witness: It was so. The cholera had begun to decline before that time, but the date of it was, I think, at that period. There is another letter from Mr. Bazalgette, informing the Registrar-General of the fact that the pumping has been completed. The cholera was at the time fast passing away. I believe animal charcoal to be the only means by which water can be completely purified, but such a system of purification is altogether inapplicable at the works. It should be done at the point of distribution; but not only would it be too expensive, it is ineffective; because, if ever so pure and good water were supplied to the poor people generally, the filthy condition of the receptacles for it would render that water impure again.

Colonel HOGG: Do you think that water deteriorates when it gets into the house from what it was in the pipes?

Witness: In the poorer houses the water-butts are almost always in close proximity to the water-closets, and the emanations from the water-closet are no doubt absorbed by that water. In better houses they are more particular; but a very large proportion of the water supplied by the water companies is for watering streets, and so on, for which filtering the water is an expensive and useless process. Sand is sufficient for all that, and the public should filter it at their own houses. There are 3 feet of sand on the filter-beds.

Mr. HEADLAM: As I understand you, amongst the constituents of this East London water, chloride of sodium is the only one which proves in any way the existence of sewage matter?

Witness: That is the only one upon which we can rely. As to organic matter, we do not know whence it comes, but the chloride of sodium must

no doubt have had its origin in matters discharged from the animal body. There is no large proportion of it in the East London water, as compared with that supplied by other companies. In pure rain water there is no chloride of sodium, unless it be by the sea-shore, and then the rain water brings down a certain quantity of the spray of the sea, which is physically suspended in the atmosphere. Rain water contains also nitrates and organic matter, and foul matter in towns sometimes.

Mr. HEADLAM: Do you think it is consistent with the extreme impurity of which we have heard, as regards the state of the Lea higher up, that the water should be as pure as you find it in those analyses?

Witness: I think it is consistent, because the processes of self-purification are so powerful. The fish and plants are using up all this matter. The common salt contained in the water, and which, no doubt, has had its origin in sewage, is taken up by the plants.

Mr. HEADLAM: Supposing you were to take the sewage at Barking Creek, as it comes out from the London districts, and that sewage were to run for a certain distance through a gravelly country, for instance, how long would it run before it became pure water?

Witness: In the first place, sewage alone requires a very long time to undergo the process of self-purification. The sewage discharged into the Stort, at Bishop's Stortford, does not render the water of the river in the condition of the sewage discharged at Barking Creek. We consider, in the first place, that sewage must be mixed with twenty times its bulk of good water, in order to be in a condition to undergo oxidation. Then a flow of nine miles will deodorize it, and make it so pure that I should not have the least hesitation in using it. Without the mixture of 20 to 1, it would probably want 9 times 20 miles to run, or something like that. It is merely a question of degree, the atmosphere is not capable of doing an unlimited amount of work. If you only gave it space enough, the sewage from London would become perfectly pure water in time, after running through a considerable distance. The first plants to grow in it would be the sewage fungus. They would effect a great purification. Then there would be the river ranunculus; then plants like watercresses; then the flags which you see growing on the river banks; and then the American weed; and we know step by step, as those plants make their appearance, what is the purity of the water, and in the end there would be nothing there. I believe the main sewer by Hackney is tapped by some of the watercress people, and they let it run through the watercress beds, and when it comes out it is so pure as to be fit for domestic purposes. In the upper Thames, the river is sensibly purer after passing through a great mass of weeds than after passing through a large town.

The CHAIRMAN: Are you aware that the cholera reached its maximum in the week ending the 4th of August?

Witness: I have taken the numbers down, week by week, as they have been published, and if you take the average of all London it reached its maximum then; but taking different districts, you will find that the mortality was at its maximum the week ending the 28th of July in Limehouse, and also in Mile-End Old Town, and also at Bow, and also at Poplar. It reached its maximum in the next week, ending the 4th of August, in most of the other places, but it was in the week following—that is, the week ending the 11th of August, that again it reached its maximum in St. Georges's-in-the-East. Therefore there were three different maximum points in the different parts of London. I cannot ascribe its increase or diminution to any particular cause; the experience we have had in this last visitation has thrown no light on the origin of cholera, except two things—first, that those in an elevated position are protected to a large extent, and that those in the low-lying districts suffer most; and, in the next place, it is found that the general habits of the people, and particularly the fact of dissipation, has a good deal to do with the propagation of disease, and that accounts for the severity of it on Tuesdays. No doubt a most important means for the diminution of cholera would be to secure a good supply of water to the water-closets of the houses. Until the Sanitary Act of 1866 in the City of London was passed, we had no power of ordering water to be laid on in the water-closets, but we have it now. When the cholera first came to this country it came in a regular progress across Europe, but the cholera in each of the former visitations, in 1833, 1849, and 1854, took from three to four years to come from India to us, and it entered always by St. Petersburg, and came down the Baltic, and so came into one or other of our ports; but it has come down the Mediterranean to us on this occasion, and has taken a different course, and has behaved in a very different manner to that in which it behaved on former occasions. The first patient who was attacked in the East-end of London was a sailor who came from Holland with a vessel full of fruit. He came from an infected port, and he brought the disease there, and the first person who afterwards caught it was a woman, who, I think, attended him, and who was brought into the London Hospital; the cholera spread from that point. I see no reason to suppose that sewage and water produce cholera, except that sewage contains a cholera discharge, otherwise we should be always having cholera. I do not know anything to warrant the supposition that the outbreak of cholera can be so connected with the state of the water in particular districts as to lead anybody to infer that the two things are associated with one another; at the same time, I am willing to admit that water is a powerful agent in carrying disease by communicating discharges.

The CHAIRMAN: Have you analyzed the water in the Lea above the point where the company takes its supply?

Witness: I think I have analyzed it at Hertford, not immediately above the point; I have taken it from the reservoir before it was filtered at Walthamstow. I have the results of that analysis. I took a sample on the 12th of January of this year, another sample on the 14th of January; one of the unfiltered water before it entered the main, and the other at the main where it entered the hospital. There were floods in the river at that time, and the water was very turbid. We had had wet weather before during the last six months. That would be hardly a fair average, but we took it at the worst time. I found the unfiltered water to contain 24 grains of solid matter in a gallon, and that the filtered water contained 23·6 grains of solid matter. The suspended matter, which gave turbidity to the water when unfiltered, was rather more than half a grain, and in the filtered water it was scarcely discoverable. I have not taken it at any other time.

Mr. KEKEWICH: Have you observed from any return whether the cholera in 1832 was more prevalent in those districts in which it has since been prevalent?

Witness: That has been so on every occasion. The Registrar-General has noted it upon every occasion. His table, in fact, gives you the relative intensity of the disease at those several elevations at each visitation. On those occasions people who were actually at work on the River Thames have not been attacked with cholera. The emanations from rivers do not seem to produce it, because those on the river do not suffer from it very severely. In the year 1849 the cholera was very bad in the Tower districts, from those open ditches. In the last visitation there was hardly any cholera at all in that district; it was looked upon as one of the healthiest districts in London. I have found that in districts where small-pox, typhus, and other diseases have prevailed as epidemics, there also cholera has succeeded with great virulence.

Mr. BENYON: With regard to the observation you made as to Blue Anchor Yard, the per centage was very large. I think that it was 144·9 per 10,000?

Witness: It was nearly 145 per 10,000, whereas in the neighbourhood it was only half per centage. Mr. Liddell has taken the numbers of people who were living in Blue Anchor Yard at that time, but I have not taken them; I should think there must be 700 or 800 people living there. 432·89 was the proportion of the deaths in the Whitechapel district.

Mr. CLERK stated that that was the case for the bill.

Mr. HENRY JAMES said that with regard to the opposition of Mr. Bosanquet, it had been arranged to refer the matter to the arbitration of an eminent member of the bar to decide what rights in the water, if any, existed.

Mr. CRIPPS addressed the committee on behalf of the Metropolitan Board of Works against the bill.

J. W. Bazalgette, Esq., examined by Mr. WILKINSON.

I am engineer to the Metropolitan Board of Works, and in that capacity it is my duty to examine and report upon all bills in Parliament affecting the department under my control, and I have discharged that duty with reference to the present bill, and presented to the Metropolitan Board of Works a report upon that, among other bills, in February of the present year. At that time the bill proposed a great many other matters, which have since been struck out. I reported particularly upon the portion of the bill which proposed to continue the intercepting channel, which they now already have constructed, to a higher point. I reported, with reference to those works of interception, that the works did not appear to be such as would purify the water of the Lea within the metropolis, and that to be effective they should be of a more comprehensive character. The alteration made in the bill by striking out altogether those proposed works has not in any degree removed my objection to the bill; it has increased it. I think that it would be expedient first to take measures to purify the water, before measures for an increased supply are sanctioned. The East London Company are more deeply interested in carrying out any works for purification in that district than any other body, and I should expect from them a very considerable contribution to any plan for such purification. In my judgment, if the increased privileges which are now sought were granted, I fear no works of purification would be carried out for many years, if ever. I have made no analysis of water, or anything of that sort, but I have had considerable official experience of the importance of purity of water, with respect specially to outbreak of cholera. I remember very well the outbreak in the neighbourhood of Golden Square about 12 years ago. There were various theories as to the cause, and there was an inquiry into the subject by medical gentlemen appointed by Government, and others. The result of that inquiry was reported by them to the effect that all persons who had drunk water from a public pump in the district were attacked by cholera. First they ascertained that a sewer a few years before had been constructed in that street, near to the pump, in a gravelly soil, and that percolation had taken place from the sewer into the pump-well; and a remarkable feature of the case was, that the water was very bright and clear to all appearance, but it was very fatal. Then I have a very clear recollection of attending an inquest upon certain deaths from cholera in the Stockwell Road, near to Clapham Rise. The persons in almost every house in a certain terrace there were affected with cholera, and it was clearly attributable to wells being sunk in the gravel, and to cesspools having been sunk into the same soil, and to percolation having taken place from one to the other. Very many other cases of the same kind have come under my knowledge and observation. I think that there can be no two opinions as to whether it is essential to exclude sewage altogether from water of this character.

Mr. WILKINSON: Are you aware that the Metropolitan Board of Works have received from various vestricts and district boards reports complaining of the quality of the water of the Lea which is at present supplied.

Mr. CLERK objected that if it was proposed to attack the purity of the East London Company's water, chemical evidence must be adduced in support of the allegation.

The CHAIRMAN stated that the reference was only to the general theory, that water might be a vehicle for diffusing cholera.

Mr. CRIPPS called attention to the fact that these reports had been already referred to, and that parts of them were on the notes.

Mr. WILKINSON: Have you read the report particularly of Mr. Knight, the chief surveyor to the vestry of Mile-End Old Town, and do you concur in the statements made by him with reference to the state of the water at the different points indicated in that report?

Witness: I think so. Mr. Knight in his report describes certain points at which the sewage flows into the river, and he describes them correctly. I also confirm the truth of the report made by Mr. Leman, the chairman of the Board of Works for the Poplar district, that there is a very large amount of sewage going into the river from which the East London Water Company obtain their supply.

Mr. WILKINSON: A suggestion was made by Dr. Letheby, I think, that the passing of the sewage water through pipes to a considerable length would eventually purify it of all sewage matter. You have, I think, under your consideration a very large project for taking the London sewage to the Essex Marshes, have you not?

Witness: I do not think that was quite Dr. Letheby's statement. I think his statement is that, passing sewage through open channels and mixing it with fresh water, would tend to purify it. I think he stated that sewage by itself, unless it is so diluted and exposed to the air, would not become purified, or at least not for a long time. I have a plan by which the sewage can be intercepted from the river Lea without draining the valley of the water. That is the plan upon which I reported to the committee of the Tottenham Local Board of Health. The recommendations contained in that report were, that application be made to Parliament during the next session for power to form the area named therein, or such modifications thereof as might hereafter be thought desirable, into a sewerage district; also to carry out the scheme of drainage generally delineated on the plan, and described in the report; and to form a commission or board, at which all portions of the district and the several water companies should be fairly represented, with power to borrow money on the security of the rates or other property for a term, and at interest, and to receive proper contributions from the East London Water-Works Company, the River Lea Trustees, and the New River Water Company, for the execution of the drainage works, and with power to levy a sewerage-rate over the whole of the district for the repayment thereof, such rate not to exceed a limit to be defined. By that scheme each of the towns whose sewage was intercepted would have, in addition to their contributions towards this, the main system of outfall, to carry out a complete system of drainage for themselves, and, in point of fact, the only body who would derive any large pecuniary advantage from this scheme would be the East London Water-Works Company. All the other parties would be contributors to carrying out a better system

of drainage, but they would derive no return from that; whereas the East London Water-Works Company would have the whole water, and would, therefore, get something beneficial to themselves for the outlay. I think that the New River Company should contribute, but nothing nearly so largely as the East London Water-Works Company, because this system will form an outlet for additional drainage, which is likely to occur all round Hertford, above their source of supply, as the buildings extend in that direction. The New River Company would derive benefit by the diversion of some sewage at the present time. It would give them an outfall as the buildings increase in that neighbourhood, as there is very little doubt that they will, by means of which outfall they would get rid of the sewage in the New River. I think that there is good reason to suppose that such a scheme will be carried out if the different persons interested can be got to work harmoniously to carry it out, for this reason: At the present time there is an injunction pending against the discharge of the drainage of Tottenham into the river Lea, and they will have to do something; and Barnet, I believe, is in the same position. The whole of that district is now becoming so rapidly built over, that each portion of the district is applying for an injunction against the portion of the district immediately above it, and which drains through it. The Colney Hatch Lunatic Asylum drains through part of the district, and they are threatened with an injunction, if one is not yet applied for. I think the whole drainage of the district is coming to a point when something must shortly be done, and I think they are beginning to feel it. My attention has been called to the report of the commission which is sitting for preventing the pollution of rivers. In the recommendations of that report, I observe nothing that at all militates against the suggestion in my special report to the Tottenham Board of Health; on the contrary, I agree with the suggestions of the report of the Rivers Commission, as being somewhat auxiliary to the measures which I suggest. The bill having now been reduced to an imperfect state by omitting the obligation to which the company itself consented, I think that the passing of the bill in that imperfect state would go very far to prevent the project which I recommended being carried out. I think, under these circumstances, that in the interests of that district, supposing the bill to pass, some obligation should be imposed upon the company of contributing to any future comprehensive scheme which might be carried out.

Cross-examined by Mr. HOPE SCOTT: Probably I can point out no clause in the bill which will interfere with my drainage scheme; but there is nothing that will promote it, and without something to promote it, it will never be carried out. I oppose the passing of the bill because I think that it will be exceedingly injurious to the district to admit of the water being taken from the river Lea without any provision for purifying that water. I know that it must be taken from the river Lea at present, under the Acts of the East London Company, but you propose to take more now and that is bad. I do not object to filling up the old reservoirs at Old Ford, but I do object to a new filter-bed; what I do object to is anything which will store more water for consumption. If the company needs more water and cannot get it anywhere else than from the Lea, which I say is an impure source, I should say purify the water first. I do not think that this impounding is necessary. I know that it is very objectionable. I am quite sure that if this bill is once carried, the East London Company will be very indifferent about carrying out any works of purification. I think the bill is damaged by their giving it up.

Mr. HOPE SCOTT: But you said in your report, which has been read, that in view of this general scheme, "it would be unnecessary for the East London Water Company to execute the sewerage works contemplated by them for the partial purification of the upper portion of the river Lea." You have seen no reason to change your opinions, as you told my learned friend.

Witness: I desire them to carry out works of a more comprehensive kind. As the matter stands at the present moment, my objection is to the omission of the sewers, because to some extent they purify the water of the Lea. I think it is most destructive to the interests of those who take the water. There is no attempt at purification now, there was there.

Mr. HOPE SCOTT: But you are now upon your sewage scheme. Do you mean to inform the committee that it would be compatible with your general scheme that this water company should have made those works which you declare in one passage to be unnecessary, and in another passage to be ineffective?

Witness: I neither declare them to be unnecessary nor ineffective. I say that if the general scheme is carried out, then the partial works are necessary. I say that the works proposed by you would have done some good, but not the whole good, and I think that the abandonment of those works is most injurious to your bill without proposing anything else. The purification of the Thames Bill became an Act in 1866, and there is a bill pending now for further purification. Some 14 years before any bill was passed for the purification of the Thames, the Thames companies were sent *de novo* to take their water from the Thames at Teddington Lock. Then the scheme for the purification of the Thames came forward, and the companies did not resist it.

Mr. HOPE SCOTT: Do you know that they have contributed to it, and that they have undertaken to pay £1000 a year each to the conservancy of the Thames towards that?

Witness: Not towards the scheme for the purification of the Thames. The Thames Conservators had nothing to do with that.

Mr. HOPE SCOTT: You do not seem to have read the Act, but the committee have the Act before them. Why should the East London Company have a less interest in purifying the Lea after they get an additional supply than the Thames companies in contributing to the purification of the Thames, after, by Act of Parliament, they had been settled upon the Thames?

Witness: I cannot go into the reasons which have induced the other companies to contribute. There may be various reasons operating upon them. I am quite sure that if the East London Company get their bill without any works of purification they will be very much less likely to carry out the matter afterwards.

Re-examined by Mr. CRIPPS: The whole of my statement about the East London Water Company's finding it unnecessary to execute those sewerage works depends upon the supposition that a more comprehensive system could be carried out. Assuming that that more comprehensive system is not carried out, I consider it would be a fatal objection to the bill that they have taken out of even the moderate amount of works what they had proposed by it. My objection to these works is not in any way to the principle of an intercepting sewer; it is that they do not sufficiently purify the water.

Mr. CRIPPS: You were asked about the other companies having contributed to the Thames supply. In 1852 there was no project for the purification of the Thames, was there?

The CHAIRMAN stated that all these matters were contained in the Act of Parliament.

Mr. CRIPPS remarked that the question of remedying the pollution of the Thames had hardly arisen when the Thames companies were compelled to go to Teddington Lock.

Mr. CLERK intimated that there was a Thames Purification Bill in Parliament in the year 1852.

Mr. CRIPPS: What I apprehend you to say is that the East London Company is the party which has the main and principal interest in the purification of the Lea, and, therefore, if you take away that interest from those who now hold it, by giving them this bill, there would be nobody left to move in the matter, and that you think very undesirable?

Witness: I think it is very important indeed that it should be carried out. There is nothing in this recommendation of the River Lea Commissioners which is at all inconsistent with my scheme. I think that it might be equally well carried out with that.

By the CHAIRMAN: I think the Croydon system of disposing of the sewage continues to be successful. There is a difference of opinion as to the acreage required per head of the population to dispose of the sewage successfully on the land, but I imagine 100 people to an acre is somewhere above the number. I am afraid that I cannot give the number of acres within the drainage area upon my map which are now under cultivation, but I do not think it is an area which is suitable for irrigation, because it is studded all over with buildings, and buildings are going on rapidly. I can give you the average of it at the next sitting of the committee. The population I have given. It is only to calculate the acreage. My system would not affect any of the tributaries of the Lea; it only applies to the Lea up to Hertford. It is capable of extension further, but my view was that having got to Hertford you get into a more rural district, and there, probably, the sewage would be susceptible of application to land in the form of irrigation. No doubt the meadows below Hertford are fully sufficient for ten times the sewage of Hertford, if anybody chose to apply it to the land. There are thousands of acres of upland suitable for building if anybody wished to build, but I would not apply the sewage of towns to land near to the towns where it could be avoided. At Croydon it is carried some considerable distance before it is applied to the land. At Hertford there is a very large acreage of meadow land quite disconnected with any buildings or houses, but it must be borne in mind that the great expense of this intercepting sewer is at the lower end. It is almost entirely from Tottenham to Barking. After that the sewers become very much smaller, and are much less costly. I have not included in my report any towns below Hertford and Ware.

The CHAIRMAN: Looking to the extent of agricultural land, and the success which has attended the application of sewage at Croydon, do you see any necessity for beginning any system for carrying off the sewage to the River Thames, beginning so high up as you have proposed?

Witness: Yes; in the upper portion of that work the sewers are very small, and very cheaply constructed, and for that reason I think it is desirable.

The CHAIRMAN: But what necessity is there to carry all the sewage from Hertford to London, and from London to the sea-shore, when there are thousands of acres to which it can be applied at a moderate distance from all those towns?

Witness: For instance, near Hertford, there may be meadows which you could irrigate, but the whole of that valley is thickly peopled—certainly up to Walthamstow, and round by Barnet, Enfield, and all that neighbourhood, and there is no place where you could irrigate satisfactorily on account of the population. I have been all over the ground to see whether there were suitable places for irrigation.

The CHAIRMAN: Having regard to the irrigation going on at Croydon, and the population there, and the extent of the land there, would it not be accurate to say that there are ten times the facilities in the valley of the Lea than there are at Croydon?

Witness: I think not.

The CHAIRMAN: Perhaps you will give the committee a statement of the area and population in the district?

Witness: Yes, it must be borne in mind that with regard to the area you cannot take the whole as available for irrigation unless you go to the expense of pumping the sewage upon it. With reference to the different levels, if you take the boundary which I have given, there is a general fall towards London, and the natural inclination and flow of the sewage would be towards London, and I say that within that area there is no locality which is suitable for the application of sewage by irrigation. That is a subject which has been considered a great deal by other engineers before I considered it, and I think that there has been a general agreement upon the subject, because they have been pressed very much to get rid of their sewage, and there has been a great difficulty in doing it. There are those who contend that a much larger acreage than I have stated is necessary, but I take Croydon as a standard, and I think that 100 people to an acre is a fair and proper number.

The CHAIRMAN: As regards the area drained in that district, it appears that there are 153,000 people in the district between Hertford and Ponder's End; that, therefore, would require 1530 acres to dispose of all the sewage?

Witness: Yes; I do not know how many thousand acres there are now under agriculture in that district, but I should think many thousands.

Mr. BENYON: Are you aware that there are deodorizing works for the sewage of Hertford?

Witness: Yes, at Hertford, Tottenham, and Colney Hatch. Hertford is the only material town which is above the source from which the New River Company takes its supply from the Lea. I think that the New River Company ought to contribute to the expense of the drainage system, because I look upon that district as one which will in the course of a few years be very much built over, and such a system of sewers will afford an outfall for the drainage of the whole of that area.

Mr. BENYON: But the New River Company has nothing whatever to do with that district, except up above Hertford, because it takes its supply from Hertford, does it not?

Witness: Yes, but I take it that there will be building just above Hertford the source of their supply, and they have gone to a very large expense in getting rid of the sewage of Hertford.

The CHAIRMAN: Apart from the objection which you have raised, do you consider that the works proposed would improve the water supply of the East London Company?

Witness: It would increase their supply. I think that getting rid of the old reservoir would be an improvement; but I have not looked into that question myself. The storeage of 300 million gallons of water would tend to improve the quantity of the supply, but I do not think that it would improve the quality.

Mr. CLERK: Would it not enable the company to shut out the first waters of a flood, and to take in only the subsequent waters?

Witness: Of course they could do that, but if they are short of water they will take in all they can get, I suppose. I do not see that it would be a means of equalizing the supply, so as to enable them to select the best flood water, and to reject the grosser flood waters, and so improving the

quality of the water. I think that my scheme is clearly the only thing that would purify the water.

The CHAIRMAN: Have you considered in what per centage of the river Lea would be reduced if your scheme were carried out?

Witness: I think not at all; the same volume of water would flow down the river in dry and wet weather if the works were properly constructed. It would require a good deal of care in forming the sewers to have no leakage into them; but, as every one knows, that is a mere question of expense.

Mr. WILKINSON said this was the case for the Metropolitan Board of Works against the bill.

Mr. PEMBER said he did not propose to call witnesses on the preamble of the bill in support of the opposition of the River Lea Trustees.

Mr. JOHNSON stated that the opposition of Mr. Hunt was withdrawn.

(*To be continued.*)

Miscellaneous News.

EUROPEAN GAS COMPANY, LIMITED.

The Annual General Meeting of the Shareholders of this Company was held at the Office, No. 4, Frederick's Place, Old Jewry, on Wednesday, July 10—SHEFFIELD NEAVE, Esq., in the chair.

The SECRETARY (Mr. H. M'L. Backler) having read the notice convening this meeting and the minutes of the last meeting, the following report was presented:—

Amiens.—Increase of lights, 377. Notwithstanding the disastrous effect of the cholera on the trade of this city, the amount of the previous year's profits would have been maintained had it not been for the augmented cost of coals which, at this, as at the three stations next referred to, has exceeded the amount of additional gains which have been realized from the increase of business.

The construction of the new chimney and retort-house is progressing satisfactorily.

It will shortly be necessary to provide additional storeage for gas, but the large outlay required for a new gasholder will be deferred as long as possible by making use of the present apparatus during the coming winter to the utmost of its capacity, and by telescoping one of the gasholders afterwards at a comparatively small cost.

Boulogne-sur-Mer.—Increase of lights, 1163. The remarks made, with reference to the cholera and price of coals, under the head of Amiens, are in like measure applicable to this station. A large number of new lights, however, has been obtained both in shops and private houses, which is, under such circumstances, a very encouraging feature, and full of promise as regards the future prosperity of this portion of your undertaking.

Caen.—Increase of ilghts, 352. The rental for gas has increased to a moderate amount, and the profits would have exceeded those of the previous year had it not been for the unfavourable conditions under which the coals used had to be procured.

Havre and Ste. Adresse.—Increase of lights, 1682. It was found impracticable to dispose of the coke produced at this station, except at a low price, and this, combined with the extra cost of coals, affects the accounts of the year to the large amount of £1120, and occasions a diminution of profits, whereas, under circumstances similar to those of the period with which the comparison is made, an increase would have been effected.

The construction of the new gasholder and tank is proceeding rapidly, and, so far, satisfactorily.

Towards the close of the financial year the almost sudden death of the highly valued superintendent of this station seemed to threaten some disturbance in the mode of management, occurring as it did at a time when the above important work was already in progress; but the organization of the staff was found well adapted to meet such an emergency, and every department was satisfactorily conducted, pending the appointment of a successor.

Nantes and Suburban Districts.—Increase of lights, 2334. Your directors point with much satisfaction to the full realization of their anticipations, this being now the most productive of the six stations possessed by the company.

The authorities are urgent in enforcing the terms of the concession with regard to extension of mains to every part of this large city: 7¼ miles of pipes were laid accordingly during the past year, and the annual outlay for a like purpose will be considerable, until gas shall have been substituted for oil in every street. Hitherto the result has not been unfavourable, a considerable number of private lights having been obtained on the new mains.

Although the lighting of the additional districts of Chantenay and Rézé only came into operation late in November, it has already yielded returns which fully justify the small outlay made to secure the privilege of supplying them with gas.

Should the business of the company continue to improve in the same ratio as during the past two years, it will be necessary shortly to increase the storeage for gas. This can be effected without any large addition of capital by telescoping one of the existing gasholders.

Rouen, Sotteville, and Suburban Districts.—Increase of lights, 1087. The results obtained confirm the expectations expressed in the last report. Energetic measures have been, and are being taken, to secure still more favourable returns for the future.

The new gasholder is now in course of erection, to be ready for the heavy winter consumption.

Summary.—Increase of lights, 6995. It should be borne in mind that a portion of the large amount of repairs and exceptional alterations not chargeable to capital account, paid for at the stations in the years 1865 and 1866, had been reserved as appertaining in a measure to the immediate uses of coming years. This has been entirely provided for out of the profits of the past year, so as to make it unnecessary to trench on the ordinary earnings of any future year.

That the prosperity of the company should have grown sufficiently to admit of this being done at once is a subject for congratulation, especially when it is considered that the period was a trying one, in regard to the important rise in the cost of coals, without a corresponding addition to the price of coke. Moreover, the cholera had, for a time, a serious effect in checking business, and, later, the rumours of war had a depressing influence on trade, any interruption to which must necessarily prejudice the interests of this company.

Your directors consider that the position of your affairs was never more healthy than at the present time, and that the prospects of the undertaking are such as to encourage hopeful anticipations of still greater prosperity.

Your directors recommend the payment of the usual dividend, at the rate of 8 per cent. per annum, on both old and new shares, together with a bonus at the rate of 2 per cent. per annum, making 10 per cent. for the year. After providing for this, together with the interest on debentures issued, which exceeds the amount of the previous year by £169 4s. 3d., a balance will remain of £466 13s. 10d. to be added to the reserve-fund.

Notice has been given that two of your directors (Lewis Cubitt, Esq., and Walter Thomas Fawcett, Esq.), and both auditors (Felix Ladbroke, Esq., and William Jones Lewis, Esq.) retire from office at this meeting, but, being eligible, will be proposed for re-election.

Since the notices calling the present meeting were printed, death has removed one of the members of the board, Mr. William Stephen Dew, whose co-operation during 17 years in the management of the company had proved of great value to its interests. Earnest and energetic, he was at the same time conciliating and amiable, and was highly esteemed by the colleagues, who lament his loss.

The number of directors having been thus reduced to less than that required by the regulations of the company, the board might have exercised the power reserved to them of nominating a gentleman to fill the vacancy during the interval before the meeting of proprietors; which, however, being so immediately at hand, your directors have preferred to leave the selection to the shareholders, and an early day will be fixed for the election accordingly.

The CHAIRMAN: Gentlemen, you will have seen by the report that though the three or four first-named stations exhibit some little diminution as compared with last year (and I think I observed, while the secretary was reading the report, that the countenances of the proprietors did not look very happy at the intelligence), the difference has been set right at the other stations, the success of which does more than redeem the loss on those that are deficient. That deficiency has been explained to you, and you must carry with you the thought that, in speaking of the deficiency, we have paid upwards of £3400 over and above your dividend to clear off an amount which had relation to large alterations throughout the stations, and which, as we mentioned in a former report, we were exceedingly jealous of fastening on the capital account. Being alterations and not new works, though still for the benefit of the company, we consider they ought to come out of the current wear and tear apportionment. We stated to you in a former report that, as these alterations were not merely to redeem depreciation or dilapidations, but were actually going to contribute, and contribute largely, to the advantage of succeeding years, we thought it was right not to charge the whole amount to the year in which they were done, but to spread it over those future years which were to reap a large share of the benefits, still keeping it within the limits of the ordinary current account, and not carrying it over, as some people are inclined to think we should do to outlay account. It is a proof, gentlemen, of the prosperity of this year over previous years that we have been enabled to clear off the whole amount from that source instead of dividing it over many years. Therefore, in looking over and comparing the results of this year's working with the last, you must carry with you the thought that we have made upwards of £3400 more profit than appears in dividend, and which has been appropriated to clear off this debt, added to which we are enabled to carry to the reserve-fund upwards of £400, making the total of that fund, at the present time, above £3000. I cannot say that that is a very large surplus for a company having a capital employed of £500,000; still it must, I think, be very gratifying to you to know that we are year by year adding something to it, and not taking anything from it. On a former occasion we ventured to adopt what some might have thought too sanguine an expectation as to what the result of this year's operations would be. But we saw, as we imagined, a revival approaching, which, as you see, has been realized; and we thought we were justified in predicting that the accounts now presented to you would be very acceptable. I have no doubt that they have proved so, and I think I may take it that you are satisfied with our additional gain. It must be a source of gratification to us when we consider that during the last six or seven years we have been obliged, in consequence of the increase of the towns which we supply, to make very large outlays—we have expended above £200,000 in the last seven years—that we have been able to realize a sufficiency of profit to pay 10 per cent. dividends upon the whole of that expenditure. When you add to this consideration the fact of the prospects which are before us, I think you will agree with me that these are matters upon which we may fairly congratulate ourselves. Gentlemen, since our last meeting we have lost one of our directors—Mr. Dew. His character was well known to you all, and I can only say, in addition to what is stated in the report, that as a member of the board we regret his loss very much indeed. He was a man with whom for seventeen years we had cheerfully co-operated; he was very able and very industrious, and you have lost in him a very excellent director. I am sorry that it is so; for I assure you that we, from our intimacy with him, feel his loss keenly, not only as a member of the board who has done all in his power to further the interests of the company, but from our knowledge of his individual character. He was extremely amiable and courteous, and a man with whom we could work very harmoniously. I need not attempt to impress upon you the advantage—not only pleasurable to ourselves, but of immense importance to you—that the board should act harmoniously. We are a committee of five, which, perhaps, is rather a small number for the large business we are working, but you know that small committees generally do their work better, provided they pull together, than larger ones. We have been very fortunate in this respect, and I may say that I am convinced your interests have been materially advanced by such harmony and co-operation. When, therefore, one of our number, eminently gifted with those qualities which contribute to produce that harmony, is withdrawn from us, you may readily imagine that it is a source of deep regret to us. I do not think that I have anything further to say upon the report, which, in fact, speaks for itself, and therefore I will only add that I shall be happy to answer any questions you may be desirous of putting to me. I move—"That the report of the directors now read be received and adopted."

Mr. T. N. STOKES seconded the motion.

Mr. HUGGINS: I should like to ask whether there has been any addition to the capital during the past year.

The CHAIRMAN: None.

Mr. HUGGINS: I mean whether there has been any outlay on capital account at the different stations. I did not gather from your remarks, or from the reading of the report itself, that there had been any additions during the past year. But I think we ought to know from time to time whether any such outlay has taken place—it ought to speak for itself on the face of the accounts.

The SECRETARY: It is stated in the accounts laid before the meeting to-day.

Mr. HUGGINS: I see the account begins with the sum of £516,289 13s., and it ends with a sum of £533,000 odd. Am I to understand that the difference between these two amounts has been spent during the year?

The CHAIRMAN: You are to understand that the £516,289, under the head of capital account, includes the five amounts of the extension-fund, shareholders capital, bonds and debentures, and the depreciation fund.

Mr. HUGGINS: In that case it would appear that £16,000 or £17,000 have been spent in the past year.

The CHAIRMAN: The amount expended is £15,100, as far as my recollection goes.

Mr. HUGGINS: I think it is quite as well that we should know from time to time what has been expended.

The CHAIRMAN: It is quite right for you to ask the question, but I want you to see that by a comparison of the present accounts with those of last year you already have the information. The increased outlay at the different stations is £15,100, and with the fittings it amounts to £16,100 altogether.

Mr. HUGGINS: There is another item in the accounts I should like to have explained. It is "Extension-fund account, £14,000." What does that mean?

The CHAIRMAN: That is an extension-fund, which, as you are all aware, has been in existence for a good many years. We charge interest upon that sum, and therefore the fund, which last year was £13,799, now amounts to £14,489, the interest, which we take out of profits, being charged to it.

Mr. HUGGINS; How is that fund invested?

The CHAIRMAN: It has been all employed in outlays upon the works.

Mr. HUGGINS: These are the only questions I wish to put. I quite feel that in all other respects the accounts are very satisfactory, and that the prospects of the undertaking are very cheering.

A PROPRIETOR: What is the amount of the reserve-fund?

The CHAIRMAN: We have added £400 to it this year, which has brought it up to £3446.

The PROPRIETOR: It is but a small amount. I should like to know whether it is available for immediate contingencies if necessary. How is it employed?

The CHAIRMAN: It is in your general account, which is moneys lent to the stations for ordinary use, varying in amount from year to year. We have not invested it in the funds, or in Exchequer Bills, or anything of that sort, because we can find more beneficial employment for it.

The PROPRIETOR: What I want to know is, is it in the Bank, and therefore immediately available?

The CHAIRMAN: No, it is not. It belongs to our general fund, and it is much better, financially, that we should use it, and save your 10 per cent. upon it, than call up £3000 from the shareholders. If the time should come when it will be wanted, and it should not be forthcoming, as you seem to think, it must be obtained by a call upon you to that extent, for which we shall have to pay you 10 per cent. We forbear to call upon you for it now, and we thus save so much interest.

Another PROPRIETOR: The reserve-fund does not appear in the balance-sheet.

The SECRETARY: It is part of the profit and loss balance.

A PROPRIETOR: I should like to know upon what basis the redemption-fund is calculated?

The CHAIRMAN: The redemption-fund is calculated upon the principle of repaying us in less than the terms of our concessions.

Mr. WILMOT KNIGHT: I am not about to put any question upon specific items in the accounts, because, having only seen them since I came into the room, I do not understand them in the least. The question I am about to put is one which I know I may be told has been answered before, but unless you tell me something different from that which I have hitherto heard, it will fail to carry conviction to my mind. I want, sir, to know why the accounts are not printed and circulated among the shareholders before the meeting. I will anticipate the reply, which will probably be the stereotyped one, that to publish the accounts will be to furnish information to our opponents, which might be used to our disadvantage. It has been also said that there is no necessity to publish the accounts, seeing that the proprietors may come to the office, both before and after the meeting, and see the accounts for themselves. If the latter statement be correct, then the ground of the argument against the publication of the accounts is cut away, because the much-dreaded man who wishes to get information and use it against us can come here and obtain all that he wants.

The CHAIRMAN: It is all very well for a shareholder to come here and get such information from the accounts as will enable him to make inquiries at these meetings; but, if the accounts are published, they will find their way into the French journals, and might hereafter be used to our prejudice. The proprietors have always been of that opinion, and I certainly think it would not be to our interest that the accounts should be published.

Mr. WILMOT KNIGHT: A person holding one share might come to the office and get information from the accounts laid before him, and then use that information to damage the company.

The CHAIRMAN: No doubt a person so disposed might do something to damage his fellow shareholders, but that is a very different thing from the directors facilitating the publication of the information. I think we should get no good by it but the saving of the trouble of a few individuals.

Mr. WILMOT KNIGHT: I shall not put any motion to the meeting on the subject, but I think the course I suggest would be advantageous. You thought at one time that publicity being given to the proceedings of these meetings might damage the interests of the company, but you have now come to an opposite conclusion.

A PROPRIETOR: There is a question I should like to ask with reference to coal. It appears that we have realized no increase of profit at some of the stations, because of the price of coal and coke. I should like to know whether there is a probability of a continuance of those prices, and whether the sale of coke at a low price is owing to the poverty of the people or not.

The CHAIRMAN: The increase of coke, measured against Belgian coal, is a variable quantity; also the great increase in the use of coke, as that takes place, we shall obtain a greater advantage.

A PROPRIETOR: I am perfectly satisfied with the balance-sheet as far as it goes, but it is only up to March, 1867, which is a long time ago. I do not know whether one might ask generally how the concern is now going on. We are now in the month of July, and you might, perhaps, tell us whether everything is satisfactory—whether the cholera continues, and whether there are any particular disadvantages under which we are labouring.

The CHAIRMAN: I shall be very glad to answer you. You will observe in the last paragraph of the report that we say—"Your directors consider that the prospects of the undertaking are such as to encourage hopeful anticipations of still greater prosperity." You ask whether the features are still such as to make us believe that the prosperity of the last year is continuing. I can very agreeably answer that inquiry by saying they certainly are; nothing has gone wrong.

Another PROPRIETOR: With reference to the concluding paragraph in the report, in which it is stated that there is a vacancy at the board by reason of the death of Mr. Dew, I should like to ask in what way it is proposed to fill up the vacancy. Yesterday I received a circular from the Hon. Howe Browne, a gentleman of whom I have no knowledge, in which he states that it has been suggested by you that he should qualify himself to become a member of the board. Now to my mind it would certainly be a strong and cogent recommendation to me to know the candidate had your approval. Therefore I wish to know whether, having recommended him to be a member of the board some time ago, your good opinion still exists—whether he is a person you would desire to have join the board, as I think it is a matter of paramount importance that the board should be so constituted as to work harmoniously together.

The CHAIRMAN: At the time a vacancy occurred at the board through the death of Mr. Winkworth, we were at fault where to find a director. We did not readily see any one with what we thought the necessary qualifications that would render him useful to the company and agreeable to us. The Hon. Howe Browne, of whom I then knew nothing, was recommended as a gentleman of experience in gas affairs, and I made it my business to inquire, amongst those who knew him, whether he was a gentleman with whom we could work harmoniously. Finding that he was all we could wish, I urged him to qualify for the office. He did not respond immediately to my wishes, but after a time he consented. Some other members of the board had been looking out for candidates, and when the election came Mr. Cubitt was chosen to fill the vacancy, and a very good director he has proved. Mr. Browne has retained his qualification ever since, but, of course, we as a board having foregone the selection of a director in the place of Mr. Dew, the appointment now rests with the proprietors. In answer to the question put to me, I can only say that I entertain the highest opinion of Mr. Browne. There must be 14 days notice given of the election, and we propose to fix it for the 31st of July. There is another gentleman who is a candidate for the office—viz., Mr. Chaloner Smith.

The Hon. HOWE BROWNE: The circular which I have issued is a mere plain business matter, and there is not a single word in it which I cannot authenticate from beginning to end.

The motion was then put and carried.

The CHAIRMAN: I now move—"That a dividend at the rate of 8 per cent. per annum be declared on the old and new shares, and the first moiety thereof having been paid on the 1st of February last, that the second moiety be paid on the 1st of August next, together with a bonus of 4s. per share on the old shares and 2s. per share on the new shares, the whole to be payable out of interest and profits and free of income-tax."

Mr. FAWCETT seconded the motion, which was put and carried unanimously.

The CHAIRMAN moved, and Mr. WILMOT KNIGHT seconded, the re-election of Mr. Lewis Cubitt as a director, which was adopted.

Mr. LEWIS moved the re-election of Mr. Fawcett, and said he had the more pleasure in doing so because it fell to his lot originally to propose that gentleman as a director, and having watched his conduct during the three years he had had a seat at the board, he had every reason to feel gratified that the shareholders had elected him to that office.

Mr. SLOUS having been the seconder of Mr. Fawcett's nomination on the former occasion, had much pleasure in seconding his re-election.

The motion was unanimously adopted.

Mr. FAWCETT: Gentlemen, it happens singularly, and it is very gratifying to me, that the original mover and seconder of my election should be present and do me the honour to propose my re-election after their experience of my conduct at the board. It is true I did not undertake the position to be an idle man, and it may be satisfactory to you to know that during the last two months I have visited every station belonging to this company, and am able to bear my personal testimony as to the state and condition of those stations being beyond all praise. They are in the most efficient working order, and I warmly re-echo what the report stated in the first instance and the chairman subsequently ratified, that our prospects are of the most satisfactory and encouraging nature.

The retiring auditors, Messrs. Ladbroke and Lewis, were re-elected.

Mr. WILMOT KNIGHT, referring to the candidates for the vacant seat at the board, said he believed Mr. Browne was a gentleman of thorough business habits, and he could vote for him with a good conscience; but, if he was not mistaken, Mr. Browne had recently retired from the board of an other company on the plea that he had not time to attend to the duties of the office.

The Hon. H. BROWNE, in explanation, said the reason he retired from the company referred to was that the duties clashed with other engagements he had at the time.

A PROPRIETOR said he thought it was not fair, on this occasion, to go into the merits or position of either of the candidates. He understood that Mr. Chaloner Smith was a large shareholder.

A DIRECTOR said Mr. Smith was the largest shareholder in the company. He held 1800 shares.

Mr. SLOUS said that Mr. Browne was only known to him as the director of another gas company from which he had suffered loss, as a shareholder, for some time.

After some further conversation on the subject,

Mr. T. N. STOKES moved, and Mr. PHILLIPS seconded, a vote of thanks to the chairman and directors, which was very cordially responded to.

The CHAIRMAN, in acknowledging the vote, said: Gentlemen, I can only say you have spoilt us by your indulgence through so many years. Though every vote of thanks you give us is, it is true, an enhanced gratification, we are really spoilt children by your kindness. You have given us many complimentary resolutions, but I believe they have been founded upon your atisfaction with the labour we have bestowed upon your affairs, and the success which has attended our exertions. I hope that if we are alive, and meet you next year, we shall again receive a similar mark of your gratification and confidence.

A vote of thanks to Mr. M'L. Backler, the secretary, was then proposed, and carried unanimously.

The SECRETARY: Gentlemen, I thank you for this renewed mark of your confidence. It has always been my wish to satisfy every shareholder in the company thoroughly. If I have succeeded in doing so it is not by my own unaided efforts. I am very much indebted to the assistance I receive from the other officers of the company. Rest assured of one thing—the feeling amongst them is as the feeling of one man, to further your interests to the best of their ability. This was shown, I think, in the emergency which recently occurred at Havre. We there lost one of our best men, and every officer on the station set to work with an *esprit de corps* which I considered admirable, and with such success did they apply themselves, that for the moment we did not feel the full effect of the heavy loss we had sustained.

The proceedings then terminated.

SETTLEMENT OF THE PUBLIC LAMP QUESTION AT CHELTENHAM.

An Adjourned Meeting of the Cheltenham Improvement Commissioners was held at the Queen's Hotel, on Monday, the 8th inst.—Dr. ROBINSON in the chair—to consider a report of the Gas Committee on an amended proposition received from the gas company for the supply of gas to the public lamps to the following effect:—

The resolution of the commissioners of date the 13th inst. was read and considered.

Resolved—That, while the directors regret that they cannot accept the proposition now submitted by the commissioners as the only terms on which they are willing to enter into a contract for public lighting for three, years they are prepared to renew the present contract for one year, or, if preferred, by the year, determinable by either party at the expiration of any current year, on giving six months notice to the other of them, subject, in either case, to the following modifications, namely:—

1st.—To reduce the price now charged for gas to 3s. net per 1000 cubic feet by meter, if desired, as already proposed by the directors.

2nd.—To reduce the price now charged for the use and maintenance of plant, and lighting and extinguishing the lamps, to 14s. net per lamp per annum.

3rd.—To reduce the time allowed for lighting and extinguishing the lamps to 55 minutes per day.

4th.—To provide, at the commissioners expense, an uniform burner, to be mutually approved by the commissioners and the company, and fixed of an uniform height in all the public lamps.

5th.—To maintain a minimum illuminating power of 13 candles, to be tested by the parliamentary Birmingham Standard Burner, in manner prescribed by the company's Act of Parliament.

The minutes of the committee showed that, though regretting that the gas company should have declined to accede to the very moderate proposals of the committee, recommended the board, under all the circumstances, to renew their contract with the company for one year on the terms proposed on the 29th of June; except that the company provide the burners, and that no alteration or addition, except where necessary, be made to any of the lamp

burners, &c., without the sanction of the commissioners. The committee considered that the testing of the lamps should be in the hands of the board, as the testing proposed by the company was useless, but for the purposes of the present contract the committee recommended the board to forego their requirements in that respect.

Mr. PAUL, in moving the adoption and confirmation of the minutes, said the committee, under all the circumstances, had thought it desirable to accept the proposition which the company had made to the board. There were two most important points in the present proposal of the committee. One was that the new burners which were to be attached to each lamp, should be provided by the company instead of the board, as proposed by the company. At present, the burners were affixed to the lamps at a different altitude in each lamp, but the committee wished the burners to be affixed at a uniform elevation. The company had agreed to fix the burners as required by the board, but they wished the latter to pay for them.

Mr. SHEWELL inquired what would be the expense of providing the burners.

Mr. PAUL, in continuing, said £20 in the aggregate would probably pay for the burners. The other proposal of the committee was one of a rather negative character. It was that no alteration or addition, except necessary repairs, should be made in any of the lamps, fitting apparatus, or burners, without the sanction of the commissioners, as previously understood by the company. He (Mr. Paul) could not think but that a demand so reasonable as that would be acceded to by the company, as it only involved their asking the board's permission to carry out any alteration they might wish effected; and, moreover, he did not see how the company could dissent from it, seeing that they had already consented to the same terms in the three years contract, as originally proposed. Supposing that there would be no objection on the part of the gas company to what had been proposed, he might congratulate the board on the result of the labours of the Gas Committee, whose work for the past two or three years had been very onerous, and who had bestowed a great deal of time and a vast amount of pains on the investigation of the gas question; and he regarded whatever of solid advantage or concession was embodied in the present proposals of the gas company, as due to the untiring labours of the Gas Committee. He was quite aware that the demands of the committee had been called "unjust exactions" by an organ of the gas company—by a gentleman employed by the company; but in the end the "unjust exactions" had been cheerfully submitted to by the company. He begged to propose the adoption and confirmation of the minutes.

Mr. MARSHALL seconded the motion.

Mr. FALLON expressed the pleasure he felt at the conduct of the gas company. He spoke as a commissioner; notwithstanding that he might be told he was a mere gas director, and only cared to keep up the dividends; however, he had the interest of the ratepayers at heart, and if he had not he should be unworthy to sit at that board. He was glad to find that the gas company had acceded to the proposals of the committee. There was only one remark which had fallen from Mr. Paul to which he (Mr. Fallon) desired to allude. Mr. Paul had said that the company had acceded to what a certain organ of theirs had termed "unjust exactions" on the part of the commissioners, but he (Mr. Fallon) maintained that there was not one single thing in the present proposal which could be called unjust; but the part which could be so characterized had not been acceded to on the part of the company. That had been waived by the commissioners. He gave great credit to the committee for the way in which they had prosecuted their labours, which had resulted in the commissioners getting the town lighted on their own terms, and for this the committee deserved well at the hands of the board; but at the same time he thought it would be allowed that the gas company had always acted in a spirit of conciliation, and been desirous to meet the views of the board. He had, as a commissioner, met the gas company upon all these matters, and at their meetings he had stoutly battled for what he considered to be right and just, and had always advocated those concessions which he thought would be for the good of the town. He appealed to another gas director present at the board, whether he had not advocated a reduction in the price of gas, an increase in the time of lighting, a decrease in the price of lamps, and so on. With respect, however, to the placing of a meter to every tenth or twelfth lamp, he thought that was not a just demand, and he urged the company never to accede to it; likewise with regard to other points which, as he did not wish to mention anything likely to cause unpleasantness, he would not allude to. He was quite prepared to prove to the board that the taking of the public lighting into the commissioners own hands would never save the ratepayers one single shilling.

Mr. PARSONAGE: Question.

Mr. SWEETING having also expressed dissent,

Mr. FALLON, continuing, said Mr. Sweeting was not the vice-chairman, nor had he any right to interrupt him (Mr. Fallon). The latter gentleman was about to detail the disadvantages the commissioners would be labouring under in attempting to take the public lighting in their own hands, when, in deference to a suggestion from the clerk and to what appeared to be the general feeling of the board, he agreed to say no more on the point; this being considered unnecessary from the fact that the Gas Committee had recommended to the board the desirability of entering into a contract with the company, thus, for the present, at least, precluding any probability of the board discussing the subject or gas manufacture. With respect to the burners to be affixed to each lamp, Mr. Paul had said that the company had already agreed to that; he (Mr. Fallon) did not recollect it if they had.

Mr. PAUL said this was so.

Mr. FALLON having again expressed his doubts, and Mr. Paul having a second time assured him that they had done so in the three years contract, Mr. Fallon observed that although he was not able to answer for the company's agreeing to the condition that they should provide the burners, still it was a matter of so trifling a nature that he considered it would not be allowed to remain an obstacle in the way of an agreement between the company and the board. As to the second proposal, the object of which was to prevent the company making any alteration in the burners, he did not exactly comprehend the meaning of that.

Mr. PAUL read from the minute to the effect that no alteration or addition except necessary repairs should be made in any of the lamps, fittings, &c., without the sanction of the board. Mr. Paul reminded Mr. Fallon that this proposal had also been originally agreed to by the company in their proposal for a three years contract.

Mr. FALLON said if this was so there was an end of the matter, and he had no doubt but that the company would fall in with the views of the committee. He again expressed satisfaction with the way in which the board and the company had met each other, and hoped the latter would do all they could faithfully and honourably to carry out their contract. He concluded with contrasting Cheltenham, as regarded its gas supply, with other towns, saying that the gas was as cheap as in any other town in England, with the exception of Plymouth, where the gas was the cheapest in England. The difference between the price of gas at this town and Plymouth was 3d. per 1000 feet. A good deal had been said with regard to reducing the price of gas, and he hoped the time would shortly arrive when the company would be able to supply consumers at the rate of 2s. 3d. per 1000 feet.

Mr. W. S. DAVIS, in a speech of some length, advocated a superior quality of gas in preference to its being supplied at a lower price, remarking upon the injury caused to furniture and decorations by inferior gas. He mentioned that Mr. Purton, of Birmingham, who Mr. Davis said was a high authority on such matters, when staying at the Hotel lately, had remarked to him that the gas supplied in Cheltenham was the worst in England. While commending the Gas Committee for their efforts in endeavouring to lower the price of the article, he was sorry that they had not made greater exertions towards obtaining a better quality of gas.

Mr. PAUL: They have.

Mr. PARSONAGE said Mr. Davis must have misunderstood the question; the object of the committee had always been to secure a high illuminating power in the gas; they had not cared so much about the price. He would like to ask Mr. Fallon one question—whether the gas of 13 candles illuminating power proposed to be supplied, meant that quality supplied at the works or in the lamps?

Mr. FALLON said he could not give the information.

Mr. PARSONAGE: Because, if it means at the works, there will be one candle difference in the town.

The CLERK apprehended that the agreement meant 13 candles at the works.

Mr. WINTERBOTHAM said it would be 13 candles in the lamps; it must be where the light was burning. But if the company did not fulfil their agreement, the board had no remedy, because the company would require the board's inspector to test at the works, previously giving them notice, however, of his intention to do so. As to what had been said by Mr. Davis respecting the committee not making a prominent point of the illuminating power, it had always been their main desire to secure gas of a high quality. Even now the committee considered that a higher illuminating power of gas ought to be supplied, and that the testing ought to be in the hands of the board, for the mode of testing offered by the company was perfectly useless to the board. He mentioned that during the month of June the gas supplied for the public lamps scarcely ever exceeded 12 candles, and there were only five days in the month that 13-candle gas was supplied.

Mr. FALLON: Am I to answer all this?

Mr. WINTERBOTHAM, in continuing, said the average of the month of June did not reach 12 candles, and the board had no remedy, nor would they have under existing circumstances.

The CHAIRMAN said the words of the proposal were—that the company "agree to maintain a minimum rate of 13 candles."

Mr. WINTERBOTHAM again mentioned that the committee were desirous of adhering to their original proposal as regarded the supply of gas, but that they had only brought the present scheme forward in deference to what they considered the requirements of the board; and it was only in consideration of the very narrow majority with which the committee's resolutions had passed the board that they had not rigidly adhered to their proposal for a higher illuminating power.

Mr. ONLEY remarked that the only points for settlement between the board and the company were that the latter should provide the burners, and that they should make no alterations in any of the lamps, fittings, &c., without the sanction of the board. Mr. Fallon said that he would recommend the company to pay for the burners, and as to the other condition, that no alteration except necessary repairs should be made in the lamps without permission of the board, he had no doubt, as that had been agreed to by the company in their proposals for a three years contract, that the latter would not allow it to stand as an obstacle between themselves and the board. It had been stated that Cheltenham gas was the worst in England, but the board would trust to the honour of the company to give them as good a quality of gas as they could possibly supply. Mr. Onley concluded by remarking that it was not always gas of a low rate of illuminating power which worked most injury to furniture, &c., but that gas of 15 candles, in some instances, was equally injurious.

Mr. JORDAN remarked that if the board would look to the parliamentary returns they would find that there were not half a score towns in England where gas was obtained on such easy terms as it was in Cheltenham. He mentioned that the gas company had completed their contracts for coal for the ensuing year, and reminded the board that in consequence of the strike among the colliers, the company had been induced to accept a contract for coal of an inferior quality, and hence the complaints as to the bad quality of the gas. Lately, however, they had entered into a contract for a certain quantity of cannel coal, and though this would be done at some risk to the company, they would endeavour to supply the board with the highest possible illuminating power.

Mr. HARFORD expressed satisfaction with the manner in which the arrangement between the company and the board was likely to terminate, but reminded the board that exactly as the clock struck twelve the pressure was taken off.

Mr. PAUL paid a high compliment to the manner in which the gas inspector performed his duties, and said that whereas in the last two months of 1865, before the inspector was appointed, the illuminating power of the gas supplied to the town was a fraction below 12½ candles, during the year after his appointment it was a little under 14 candles. The company had given the board 14 candles during 1866, and he hoped they would be equally liberal during the present year.

Mr. FALLON observed that he had not the company's returns with him, but he believed the inspector had given the company credit for a higher rate of illuminating power than they had actually supplied.

The minutes of the committee were adopted and confirmed *nem. con.*, the clerk being requested to draw up an agreement with the clerk of the company on the basis of the committee's recommendation, and to submit it at the next meeting of the board.

ON THE WATER SUPPLY OF THE METROPOLIS, IN RELATION TO THE CONSERVANCY OF THE THAMES AND ITS TRIBUTARIES, AND THE DEMANDS OF THE WATER COMPANIES.

By J. BAILEY DENTON, Esq.

[*Paper read before the Society of Arts, June 5.*]

It may be in the recollection of some of our members that I have on several occasions raised discussion within these walls on the subject of water supply in connexion with land drainage, river improvements, and the necessity of an accurate record of rainfall.

On these and on other occasions I have treated the subject as one of national importance, affecting not the metropolis only, but extending to the whole country, being impressed with the facts, which are daily becoming more generally acknowledged, that the rainfall is getting positively, though gradually, less in quantity, from the disafforesting of woodland, the improved

cultivation of the soil, and the drainage of lands and districts; that although by the drainage of land, we gain an increase of water in the winter season we suffer a diminution in summer; and that the sewage of towns is corrupting our rivers and streams in their transit through the country to the sea, proportionately as the sewage of towns extends and the summer flow of rivers becomes less. All these influences are connectedly producing a great change in our water system, demanding the serious attention of the people and the protective care of the Government; and we cannot shut our eyes to the truth that our population is increasing at the rate of 200,000 a year, or 3845 a week, while the area of our island remains the same.

I have not hitherto laid any great stress upon the diminution of the rainfall, because it has always been considered that the position of Great Britain, in its proximity to the wide Atlantic Ocean—from the surface of which evaporation takes place to an unlimited extent, increased by the warm current of the Gulf Stream—is such as to make any diminution of rainfall resulting from reduced evaporation from the surface of our island a matter of very little moment. The valuable essay of Professor Ansted, recently published in the *Journal of the Royal Agricultural Society of England*,* however, places the matter in so clear a light, and raises its importance in the eyes of scientific men so considerably, that the subject cannot long remain one of indifference to the people at large. He shows, by very simple diagrams, formed from the records kept at Greenwich—which are reliable, I presume, and have been kept for a period extending over 50 years—that a "considerable decrease" in the amount of rain has taken place within that period. The professor, when comparing the rainfall within the period from 1814 to 1864 inclusive, states that during the first 25 years the mean annual fall was 26·69 inches, or 1·44 inch above the general mean of the 50 years, and that during the last 25 years the mean fall was 23·75 inches, or three inches less than the first 25 years. He also shows that, during succeeding periods of 7 and 14 years, from 1815 to 1863 inclusive, the decline in quantity has been as follows:—

Years.		Inches.	Mean of 14 Years. Inches.
1815–1821	Mean rainfall	26·7	28·3
1822–1828	"	27·9	
1829–1835	"	24·3	26·1
1836–1842	"	25·1	24·7
1843–1849	"	24·1	24·6
1850–1856	"	23·8	24·0
1857–1863	"	23·7	23·8

If we deduce from this instance that the rainfall is generally declining, we cannot reject from consideration the counterbalancing circumstance that land drainage, which is taking place all over the country, discharges into the rivers from the land a *larger* quantity of water than found its way to them before drainage, and more than is actually lost to the rivers by the lessened rainfall. In fact, if the whole area of the Thames watershed consisted of wet land, which would be benefited by drainage, we should, in the aggregate, be considerable gainers by the extension of the practice; but the wet lands form only the smaller portions of its area, and therefore we can only apply the advantage to that lesser extent. Moreover, it is hardly necessary to repeat, the water of drainage issuing from our clay lands is not constant; it is, for the most part, discharged in the winter months, when both soil and air are frequently in a state of saturation and when vegetation is dormant, and ceases to flow in summer when evaporation is active and the demands of vegetation can hardly be satisfied. Hence it is that the underground operation of drainage, which we adopt for the amelioration of our heavy wet lands, adds to the derangement already caused by the improved cultivation of the surface and the spread of population. It extracts from the soil, in fact, the water which has hitherto been retained to moisten the air of summer and to support our rivers. Thus the floods of winter and the droughts of summer are both increased, and the hygrometric condition of the atmosphere altered so much as to make us acknowledge that England is undergoing an appreciable change of climate.

Before passing from this point, it is right to state that if drainage consisted only of subsoil drainage the tendency would be to render floods less frequent, because the water, having to pass through the soil intermediate between the surface and the drains, would be seized and detained in that depth of earth on its way to the outfall, and if the rains were not repeated too quickly the sudden congregation of waters would be prevented. But as the primary object of drainage is to get rid of excessive wetness as soon as possible, the outlets and watercourses are now so much improved, and are every day becoming more and more improved, by straightening and widening, that the expected detention is more than counteracted by the facility afforded for the immediate discharge of both surface and drainage waters, which are precipitated into the valleys with a suddenness unknown fifty years back. The importance of this consideration can hardly be excluded from the immediate subject before us—the supply of water to the metropolis—for when this excess of water from drained lands, discharged as it is in winter, is added to the increased flow of springs and watercourses natural to that season of the year, it must be obvious that the surplus so placed at our disposal at one season to compensate for scarcity at another is a gift we ought not to reject. It is no part of the present purpose to specify with accuracy the quantity of water so placed at our command, though it is much to be regretted that the special terms of the Water Supply Commission prevented the Duke of Richmond and his colleagues from carefully inquiring into the capabilities of storeage existing, and the means of making reservoirs, within the Thames basin. It is, nevertheless, of the first importance that these points should be understood by the country, for in the inexhaustible powers of storeage exists the solution of the whole question of supplying London with economy. No one who has critically investigated it doubts the abundance of water existing in the basin of the Thames, though the prevalent opinion with the general public is the reverse.

While asserting that if storeage be resorted to the excess of the driest winter will more than compensate for the drought of the driest summer by which it may be succeeded,† I am content to place before you the following facts in support of the assertion:—

Out of the average mean rainfall of 26 inches due to the Thames basin, it requires only three-quarters of an inch of the surplus of winter from the whole watershed of the Thames, or 1¼ inch of rainfall from one moiety of the watershed, to satisfy the whole population within it. Or, to put the matter more practically, as it will only be necessary to collect water for six months of the year, half an inch of rain falling upon an acre of land is sufficient to supply two persons with 30 gallons each per diem for six months, and no winter passes by in which there does not run off to the sea, without serving any useful purpose, in excess of the mean summer flow of the river, at least five times the quantity required to meet the supply of the metropolis in the dry times of summer, when the river cannot fairly part with any portion of its volume; and this, or any portion of it, may be stored for compensation to the river if reservoirs were properly constructed for the purpose. To appreciate our present position it should be understood that the water companies are continuing the unexampled practice of abstracting from the Thames 60 million gallons daily, which may be increased to 100 millions, independent of what is now desired to be taken by the East London Water Company, without any compensation whatever, although it is acknowledged that the volume of the river (which should always be maintained, if possible, at a standard flow—say of 450 million gallons per diem) is sometimes reduced, in dry summers, after the companies have abstracted their supplies, to from 300 to 350 million gallons.

Now, I pause to ask why this one-sided practice should be continued. Is it right, with a declining rainfall and a declining summer flow, we should allow one-fifth, which may be increased to one-third, to be abstracted in summer without compensation, when, by simply storing the surplus of winter we may secure the means of returning to the river any quantity equal to that abstracted from it, when the river volume falls below a certain recognized standard height? Unfortunately, the Legislature, in its wisdom, by granting, in the first place, to the five water companies drawing their supplies from the Thames, the power of abstracting 100 millions of gallons daily, and in the next by being a party to the payment of £6400 a year by those companies to the conservators* for considerations it is difficult to understand, has sanctioned and condoned this unexampled proceeding; and, although the public interests have been prejudiced thereby, it is now too late to cancel these powers altogether. But it does not follow that a rule should not be made which shall be binding on the companies in future, obliging them to provide compensation for whatever water is taken from both the Thames and the Lea, when their volumes have fallen below a given standard at the points of abstraction, be the reduction what it may.

	By Agreement, 1852.		By Act, 1866.		
Chelsea	300	+	1000	=	1300
Grand Junction	300	+	1000	=	1300
Lambeth	200	+	1000	=	1200
Southwark & Vauxhall	300	+	1000	=	1300
West Middlesex	300	+	1000	=	1300
	1400				6400

If this proposal were adopted we should hear no more of a scarcity of water, and the superior character of the river Thames and its tributaries would be restored.

I began by stating that among the influences conspiring to disturb the water economy of the country the sewage of towns by the pollution of our streams was having a considerable weight, and as the prevention of this evil will test to the utmost the powers of conservancy, it may be well to make some general remarks, which may have their bearing upon the Thames and the Lea too.

The water-closet system has now acquired such a firm place in our household arrangements, that we cannot anticipate the use of any other vehicle but water for the discharge of sewage from towns of any size, however we may modify the system in villages, and for suburban and country houses, by the adaptation of earth-closets, which are most excellent expedients, and will no doubt come into extensive use where combination in sewerage is not necessary to effect the duties of the scavenger. It is the daily increasing use of water-closets in towns, and the immense growth of special trades and manufactures using and abusing our streams, that sets aside all previous provision.

It is admitted that rivers, to answer their full natural purpose, must serve as drains to receive the liquid refuse of their watersheds, as well as sources of water supply for the towns within them; and, perhaps, the most difficult problem to solve in the present day is, the obligation to maintain, at one and the same time, these two objects—reconciling, as it were, the antipodes of riparian service. The conclusion, I believe, to which the intelligence of the country has arrived is, that abstractedly no water can be used with impunity for drinking purposes after sewage has been mixed with it. Or, to give the matter a practical bearing, it may be more truly said that, as soon as sewage can be detected by chemical analysis to exist in an appreciable degree in the water we are called upon to drink, it is a vital error so to use it. Of course, as rivers can but maintain their natural position as the drains of their watersheds, it is not possible altogether to exclude objectionable liquid refuse; and as some of the best chemical authorities declare that the water of rivers, and the Thames among the number, if mixed with only a small proportion of clarified sewage, remains substantially innocuous, if advantaged by the oxidizing influence of a run of several miles before use, it is only necessary to determine with precision what proportion of organic matter, animal and vegetable, shall be allowed to exist in drinking waters when delivered to the consumer. If we arrive at this we practically fix the chemical standard of quality, and it then remains to determine by what means it shall be maintained. Even in their aboriginal state all rivers received organic matter in the shape of decayed vegetation, and if we ascend to the higher portions of rivers for our water supply we cannot exclude a certain amount of both animal and vegetable refuse, although the towns are comparatively small and few which are situated at the heads of rivers, and there are generally geological conditions of soil which favour the absorption of liquid matter. It is not for me to suggest what should be the standard of quality, but seeing that different companies taking water from the same spot,† deliver to their consumers water with very different proportions of organic matter, it is manifest that some rule should be fixed and accepted, and from which the water companies should not depart.

Professor Frankland stated, in his evidence before the Thames Navigation Committee of last year, that the quantity of organic matter in the Thames varied from three-quarters of a grain minimum to two grains per gallon maximum, and with such data it would not be difficult to fix a standard of purity.

Of all methods of purification the application of sewage to land is the only one to which science accredits the power of arresting objectionable matter, though the mode of application is found to govern the extent to

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* *Journal of the Royal Agricultural Society of England*, Nos. III. and V., Second Series.

† When speaking of the rainfall in years of scarcity we have been led into confusion by the published returns being tabulated according to the calendar year, whereas the summer flow of rivers depends on the preceding winter's rainfall. No month's rain has so much influence on the supply of summer as the fall of the previous October. If we have a wet October and an average wet winter the springs will be replenished and the flow of our rivers increased.

* The following are the payments made by the water companies taking their supplies from the Thames to the conservators:—

† See Appendix XIV. to the First Report of the Rivers Commission.

which the process succeeds. Sewage discharged from towns by gravitation, or lifted by mechanical power to high grounds, if it passes simply over the surface of land without passing through it, retains a large part of the noxious matter, and cannot be considered to be in a fit condition to mix with river water used for drinking. This view applies with increased force the nearer the irrigated lands approach the river. The absorbent powers of vegetation are doubtless very great, but they are not sufficient in themselves to appropriate the impurities held by water in suspension as well as in solution. Moreover, vegetation has not equal vital powers all the year round to seize and appropriate the fertilizing elements which are its food. It has its seasons of rest as well as of growth, and at such times its attractive and retentive capabilities are very small. When vegetation, however, grows on a deep bed of free soil, through which the sewage can descend and percolate, after satisfying the vegetation, we possess the best means of purification, its perfection depending quite as much on a sufficient depth of subsoil through which the effluent water must descend as upon the action of vegetation.

We must not confuse the system of irrigation which allows of the effluent water to sink into the subsoil *after satisfying vegetation* with the "dumb-well" or cesspit mode of disposing of sewage in its normal state. In the first case, the effluent water which would pass into the river as clarified sewage, if "run over land" sinks into the soil and replenishes the springs, after being utilized on the surface; whereas, in the second case, the sewage is dropped into holes of porous ground, which retain the solid matter to fester under foot, and allow the liquid sewage to sink into the earth without doing any good whatever to vegetation.

Where free soils affording natural drainage are not to be obtained, the nearest approach to them is land to which under drainage has been or may be applied, the drains in such case affording artificially a means of discharge, when the level of the drains is reached, similar in character to that which takes place in a deep bed of free soil when the descending water reaches the level of the springs. But as the depth of under drainage is limited to a few feet, the extent of purification is limited correspondingly, and though to the eye, and probably to the taste, in many instances, the discharged water from lands irrigated with sewage may be unobjectionable, I believe I am correctly stating the fact in saying that such water is seldom, if ever, free from organic matter. The question which therefore arises, when applying sewage to drained land, is whether the filtration it undergoes, in addition to absorption by vegetation is sufficient to allow of the effluent liquid from the drains being mixed with impunity with river water used for drinking. Abstractedly, it is wrong to do so; but, as under many circumstances theory cannot always be carried to its extreme, it will probably often occur that the distance to be travelled by the mixed waters before use will be sufficiently great to effect oxidization, and so remove all objection. Expediency may thus override principle, and sanction the proceeding.

As a rule, it may be assumed that the application of sewage will be profitable in proportion to the command the farmer may have over the sewage he applies. It may percolate the soil, and pass away too quickly, and a sufficient breadth of land may not be covered at a dressing. The irrigated land may, in fact, be far too open and free for the farmer's profit, though not for purification. To irrigate undrained clay lands is opposed both to profit and purification, for it cannot be expected that land already suffering from excess of the rainfall will benefit by double the quantity of sewage liquid being run over it and added to the rainfall. The same lands drained will bear any amount of irrigation with an increase of produce of good quality, though the effluent water may remain polluted; but to apply sewage to land possessing no escape through the soil is to "put the compost on to make the weeds grow ranker," for the herbage can only be coarse, and very inferior in character. When we have had more experience in sewage farming—and it will doubtless become a special business, as the River Commissioners have pointed out in their reports—it will probably be found that a system of drainage admitting of the plugging of the outlets, so as to hold back the water in the soil for a time, and to flush the drains, will be adopted. In some parts of England this plan is adopted for water irrigation with success.

Thus we are compelled to view the application of sewage to land in three ways:—

1. That sewage run over a surface of land which has neither natural nor artificial drainage to assist vegetation in retaining the deleterious elements, altogether fails to secure that degree of purity which will allow of its being discharged into rivers, from whence may be taken water for drinking purposes, though the operation may serve to clarify and improve its character sufficiently to allow of its being utilized in rivers for navigation, and for many other riparian uses.

2. That land artificially drained to a depth of a few feet affords, if irrigated, only an imperfect means, in conjunction with vegetation, of separating from sewage its objectionable elements.

3. That where sewage can be lifted to high and fertile grounds with a free and porous subsoil, which will admit of its penetration to a considerable depth after it has fed vegetation on the surface, a perfect means of purification may be attained.

With these conclusions as to the utilization of sewage and the steps to be taken to exclude it from rivers when in an objectionable condition, we have to consider how far they will be acted upon or enforced by the Board of Conservators, under whose care the Thames and its tributaries are now placed; and in my remaining observations I shall content myself by bringing before you the position and duties of the conservators of the Thames in relation to water supply, and the powers they possess of securing to the five water companies, with whom Parliament has associated them, water of unobjectionable quality.

In speaking of quality, I am aware that I shall bring to the minds of many the question of *hardness*, which is one of great importance. It forms no feature of my paper on the present occasion, because, as its title implies, it is confined to the Thames and its tributaries, and it is not possible to obtain from these sources any other character of water than that partaking of from 13° to 18° of hardness. If we were comparing the water of the Thames with other and distant sources of supply offering different qualities of water or different degrees of hardness, the object would be directly pertinent, but I desire to exclude all points which might provoke a discussion on the relative merits of the different schemes now proposed for the supply of water to London, and which would have the effect of diverting attention from the Thames. My own name, indeed, has been associated with a proposal for utilizing the upper tributaries of the Thames in conjunction with the storeage of surplus waters, in which I still retain the utmost confidence, but I do not appear here to-night as an advocate of that project, feeling that I should be abusing my connexion with the council of this society were I to do so. It cannot be denied that to exclude the question of hardness from any discussion on the supply of water to a great community like that of the metropolis, is to omit a very important element, but when you are reminded that its introduction would open up a wide field of argument as to the national policy of abstracting water from one valley to supply it to another, the power of reducing hardness by chemical appliances, and the relative healthiness of hard and soft water—the consideration of which alone would be sufficient to occupy the evening—you will probably concur with me in a desire to confine our attention to the present powers afforded by Parliament for securing to the metropolis a supply of wholesome water from the Thames through the agency of the water companies, with the support of conservancy.

The urgency of the question of metropolitan supply is demonstrated by the fact that, while we justly hesitate to take water from the high grounds surrounding the manufacturing districts of the north-west, because the increase of population in those districts is truly prodigious, and in excess of the increase of the metropolis itself, the addition each year to the population of the metropolis is 40,000, which, I need not tell you, alone exceeds the number of people in the majority of county towns in England.

To describe in detail the constitution and duties of the Board of Conservancy of the River Thames would take too much of our time, but it may be useful to state that the corporation of the City of London, who were the original conservators, transferred their powers and duties to the board constituted by the Act of 1857, and with them the obligations of an agreement entered into in 1852 with the five water companies drawing their supplies from the Thames, by which £1400 a year was arranged to be paid by these companies to the conservators, "as compensation for expenses incurred by the conservancy in consequence of the works of the companies." In 1864 the constitution of the board was reorganized, though its duties and jurisdiction were still confined to the improvement and control of the river below Staines. Those duties professedly were the maintenance of the navigation, with jurisdiction over the shores and the uses of the river, and the actual works of the board extended only to the preservation of the banks, locks, weirs, and other river works essential to the navigation, and to the dredging and scavenging of the river itself. Last year the jurisdiction of the Conservancy Board was extended from Staines as far as Cricklade, and the Legislature, considering it expedient that a provision should be made for preventing the pollution of the river, and that the five water companies drawing water from it would be benefited thereby, authorized and imposed the payment of £1000 a year from each company to the Conservancy Board, having rendered it obligatory on the part of that board to scavenge the surface of the river, in order to the removal therefrom of all substances liable to putrefaction, and to clear the river of weeds, that they might not decay. It would appear, however, that there was some doubt in the minds of the committee which settled the Act whether the presiding authority of the river might not itself be sometimes at fault, for by the 51st clause of the Act provision is made for an appeal to the Board of Trade, "should any work executed by the conservators, in the opinion of the five metropolitan companies, injuriously affect either the flow or purity of the water of the Thames." No works to be executed by the conservators seem to be contemplated by the Act of last year, nor indeed by the bill of this session, either for the increase or purification of the water of the Thames, other than those essential to a proper maintenance of the river for navigation. The actual operations of the board would appear to be limited to improving and maintaining the navigation and the supply to mills, and in scavenging the river, while its powers are extended to preventing towns and persons from polluting its waters by the discharge of sewage and obnoxious mater. The Act of last year declares that it shall not be lawful for any sewage to discharge into the river, or into any stream connected with it, within three miles of the main trunk (which provision it is presumed will shortly be extended to all the tributaries), and it requires the conservators to give notice to any person or body to discontinue the discharge of sewage after a certain time named in the notice, which shall not be less than twelve months nor more than three years, imposing a fixed penalty, payable by any one disregarding the notice, of £100, with a further penalty of £50 a day if the nuisance be continued. With the service of the notice and the legal proceedings against any one disregarding them, the direct action of the conservators—as respects the purification of the river—ends. They appear to be a valuable medium for enforcing the law.

Though they have the authority to prevent the continued abuse of the river by pollution, they cannot prevent a legitimate use of its waters as population and trades increase, and agriculture may require it; and though they would successfully resist the water companies taking out of the river more than they have parliamentary powers to take, the conservators have no power to enforce compensation from storeage, let the effect be what it may. With powers of so little practical advantage as respects water supply, it is difficult to understand for what purpose the water companies are paying the additional £5000 a year which, by the Act of 1866, they are collectively bound to pay. The first contribution of £1400 a year may be taken as payments incident to, though not directly for, the abstractions at Hampton, which in some degree affected the navigation below; but with respect to the last payment of £5000 a year there exists no similar reason, inasmuch as the companies have no additional powers given to them, either to take more water, or to abstract it higher up, where it would affect the navigation above Staines. The payment could be understood if, by any actual expenditure on the part of the Conservancy Board, the additional quantities of water the several companies have yet the power to take were positively secured to them, without raising any objection on the part of the public interested in the river. If, on the contrary, the £5000 a year is, as I have supposed, required to maintain the river banks and works for the upper navigation, it would only appear right that those interested in, and to benefit by, that navigation, should find the money, particularly as the Act recites that "if the duties of the conservancy of the upper part of the Thames were efficiently performed, the traffic on the navigation, and the income derivable therefrom, would considerably increase." With this expectation, there could have been no difficulty in raising any required amount of money by a loan, repayable by instalments, extending over a sufficient length of time to realize the assumption. As it is, however, the interests of the public have been sacrificed, and, as I have before stated, a prejudicial compromise effected. The water companies doubtless consider that they are paying their £1000 each for the privilege of drawing their water from the Thames as it passes by Hampton in whatever condition it may be secured to them by the proceedings of the conservators of the river, and that they are exonerated by the payments they make from compensating the river for any quantity they may in future take out of it, within the limits of 20 millions of gallons each, even though the flow of the Thames may from other causes be materially reduced. No doubt the companies are justified in so regarding the arrangement, but it remains with the public to say whether some modification must not take place.

The quantity of water yet to be taken from the Thames under existing Acts is 40 millions of gallons daily, and this is likely to be increased by the 10 millions required by the East London Water Company. This company, with the New River Company, have absorbed the entire dry weather volume of the Lea, after the navigation has taken its prescribed quantity, and the company is obliged to come to the Thames for its immediate wants, no effort having been made in the valley of the Lea to store its surplus waters.

So great is the increase of demand for water in the metropolis, that it may be but a very few years before the maximum quantity which the companies are empowered to take may be reached. In the meantime winters may succeed, like the last, in which the valleys of the Thames and its tributaries may be in a state of inundation, involving local losses of an immense aggregate amount; and it may be fairly asked whether a compact such as the Legislature has sanctioned shall continue to have effect without an effort being made so to balance excesses that the evil of one season may be turned to the benefit of the other.

It is only in this way that we may satisfy the question of quantity, and, having placed before you in earnest terms the difficulties resulting from the parliamentary compact I have referred to, I leave it in your hands for consideration.

I will now recall your attention to the question of quality. It may be found that the towns called upon by the conservators to discontinue the discharge of their sewage into the river may evade purification by the adoption of imperfect works. Some may have recourse to irrigation on river-side meadows without drainage, whereby, as I have already stated, the effluent water may flow into the river clear to the eye, though almost as foul as before. Others will adopt different expedients, but all will abstain as long as they can from incurring the extra expense of lifting the sewage on to high grounds, or even of under-draining the irrigated lands (which, as I have said, should always be insisted upon where natural drainage does not exist), to secure the necessary absorption which is essential to that degree of purification required by water-drinkers.*

In the meantime, the contributions of the water companies will be paid to the Board of Conservancy, and this implies an obligation strengthened by each succeeding payment.

It has never, I believe, been publicly suggested, though the proposal is worth consideration, that, as the authorities of the towns now discharging their sewage into the Thames may fairly content themselves with, and satisfy their ratepayers by adopting, the cheapest disposal of the sewage which shall legally meet the terms of the notice which may be served upon them, it may be only right that those who are requiring such a purification of the water as shall make it fit to drink should pay something towards the difference between the cost of carrying out irrigating operations which shall legally satisfy the conservators notice and those which will satisfy the water-drinkers of the metropolis.

Compared with the application of sewage to lower grounds by gravitation, the lifting of sewage on to high grounds not only involves a greater first cost, in modifying and extending the outfall works and in erecting steam-engines, pumping-stations, and appliances, but there remains as a constant outlay the cost of fuel, wages of engineer, &c., which form no items when irrigating by gravitation Does it not appear reasonable that some proportion of this outlay should be paid by those who require a degree of purity beyond simply clarifying the sewage, so that it shall satisfy navigation and other riparian uses?

To put the matter in a tangible form, and having in view the towns of Banbury, Oxford, Reading, Abingdon, Wallingford, Windsor, and the many other towns on the Thames and tributaries above Hampton, I may state that the annual cost of raising the sewage of 250,000 persons to a height of 100 feet, and to a distance of 5 miles, may be fairly taken at £5000 a year.

Now, as the £5000 a year, payable to the conservators under the Thames Navigation Act, 1866, consists of the money of the water-drinkers, though it passes through the hands of the water companies, is it not fair that the whole or part of the annual outlay required for lifting the sewage of such towns as are situated above the point of abstracting the supply to the metropolis, should be paid out of this fund? This amount (£5000), if so applied, would go a very great way towards satisfying the question of quality—assuming that the towns referred to would meet the question by taking upon themselves the extra first cost of the necessary works.

This suggestion appears equitable and right in many respects, and I leave it for your consideration, merely adding that by apportioning the £5000 a year among the towns according to population, the conservators would be relieved of the anomalous position of receiving money from the water-drinkers of the metropolis, without making any positive effort to raise the quality of the water to a standard of purity.

In bringing these remarks to a close, it will not be necessary for me to assure you that I am conscious of their imperfect nature. With a subject so large, I have experienced more difficulty in bringing what I have had to say into a small compass than in finding matter to support the few objects I have desired to make prominent. I have nevertheless managed to curtail my observations to limits which have left good time for discussion—which is the more desirable as this meeting is the last of the session.

DISCUSSION.

Mr. S. C. HOMERSHAM said, if he understood the paper aright—and he had taken some pains to do so—the question raised in it was, whether a large body of flood water should be impounded in the upper tributaries of the Thames, or in the Thames itself, and let out in dry seasons for the purpose of giving a more equable flow to the river. The writer of the paper had not said very expressly that this was his view, and he had not given, for instance, the quantity of water which ran down the river in flood times, and the quantity that flowed down in dry seasons, nor the area of the watershed of the Thames, nor, in fact, any exact data to go upon by which it could be ascertained whether such a proposition could be dealt with or not. All data of this kind—whether studiously avoided or not he could not say—certainly were kept out of the paper, and there was no proposition before the meeting except a general one that flood waters should be impounded in ordinary reservoirs and given out in seasons of drought. If they were to discuss that question intelligibly they must have data and figures of an exact and positive character, whereas the only figures of any kind given were (and he believed that they were correct), that there was an average rainfall of 26 inches in the watershed of the Thames, this being assumed from the ascertained average of the rainfall being 24 inches at Greenwich. The area of the watershed of the Thames down to the point where the water companies took their supply was 3500 square miles, or thereabouts; and the area of the watershed below Hampton to the mouth of the river was about 1500 square miles, making altogether 5000 square miles as the watershed of the whole river. But before discussing the proposition which was made, it was necessary to know what was the character of that watershed. There were some large districts of country upon which, from the physical configuration, and from the character of the soil and the rock of which they were composed, water no sooner fell than it ran off; and within a few hours after a heavy rain all the water, or nearly all, flowed off through the brooks and streams, and came down in a heavy flood. He knew districts where very large impounding reservoirs might be dry at nine o'clock in the morning, and if there were heavy rain would be quite full and running water to waste at three o'clock the same afternoon. That was the character of many soils, but there were others where there might be heavy rain, even to the extent of 1½ inch or more in the hour, but where no water at all would appear in the streams, the whole being absorbed by the drainage-ground instantly, and sinking beneath the surface, and where one might go over the ground when the rain was over and almost say that it would not be wet, and there would be no flood or water at all even in the valleys and on the lowest ground. He knew a district in one patch, of 272 square miles, where neither river, spring, nor stream was to be seen on the surface at all, the whole of the water which fell upon it being immediately absorbed into the soil and rock of which the district was composed. Now, the having to deal with a soil of that character, or with one where the water ran off immediately, were two very different things, and therefore they must examine not only the area but the character of the drainage-ground of the Thames. Of the 3500 square miles which he had given as the area of the drainage-ground down to Hampton, about 1200, or a third part, consisted of chalk, a character of soil so porous that no sooner did rain touch it than it was absorbed; there was also another portion of the drainage-ground where the subsoil was green sand, which was also another absorbent rock. Below Hampton Court he found 600 square miles of the drainage-ground to be chalk, so that in round numbers it was correct to say that one-third of the total drainage-ground consisted of a soil that absorbed water as soon as it touched it. Dealing first with the portion above Hampton, the first place where the chalk appeared in the river course was at Maidenhead, and then the river ran on for about 30 miles, following the sinuosities of the river, on chalk, after which the chalk disappeared. The level of the water standing in the saturated chalk at Maidenhead was 60 or 70 feet above Trinity high-water mark, and the level of the chalk saturated with water in the Chiltern range, beginning near and above Luton and Tring, was 450 feet above Trinity high-water mark. The variation in the line of the saturated water level in the highest point was something like 40 to 50 feet in the year, being highest, generally, about the end of June, and lowest at the end of December. There was a saying in those districts, "As the days lengthen the springs strengthen," which was really true, as up to about the longest day the water gradually rose, and from that day to the shortest day, as a general rule, it fell, the variation on an average, and taking one season with another, being about 40 or 50 feet. Now, a cubic foot of dry chalk would absorb 2½ gallons of water on an average; all chalk was not exactly of a like quality, but about one-third of the bulk of chalk consisted of small pores, and as a cubic foot would be equal to 6½ gallons, it would take up on an average considerably more than two gallons of water, so that fully a third of the cubic contents of saturated chalk was water. This was very important in considering the question before them, because, seeing that there were 1200 square miles above Hampton, where the whole rain water falling upon the ground was absorbed, and that there stood at the Chiltern ridge chalk saturated with water to the level of 450 feet above high-water mark, and to 70 feet at Maidenhead, it followed there was an average depth of 260 feet of chalk above high-water mark saturated with water, which was equal to a column of water itself 86 feet in height, so that literally there were 1200 square miles of chalk in the drainage-ground of the Thames above Hampton only, with free water in it to the depth of 86 feet. This was a matter of fact; there was no question of theory about it. The tops of the hills of the Chiltern ridge varied from 1000 to 600 or 700 feet high, and taking the average at 500 or 600 feet, the dry ground would average 200 feet down to the saturated chalk, and below that there were 360 feet of saturated chalk, equal to 86 feet of free water. A very simple calculation would show that this was equal to about 18 trillion gallons of water, or to a supply of 200 million gallons of water per day for 246 years. This could be clearly demonstrated. No doubt few persons present were sufficiently acquainted with the facts to know that when standing on those chalk hills, so dry on the surface and covered with very scanty herbage, they were really standing above quite a sea of water. That was the state of the case with regard to the large portion of the drainage-ground of the Thames before described. There was water already stored in the chalk equal to a supply of 200 million gallons per day for 246 years, even if it were never replenished. Now, taking the rainfall at 26 inches, it would be but a small amount and an under-statement to say that 10 inches went to the lower depths. From an experience of 25 years in sinking wells and so on in the chalk, he (Mr. Homersham) believed it was much nearer 20 inches, but he was content to take it at 10 inches, which would give these 1200 square miles as being replenished with a quantity equal to 408 millions of gallons of water per day for every day in the year. Now, with such an enormous natural storeage reservoir so amply filled and so amply supplied, and so constantly replenished with water from the clouds, why should they try to impound in artificial reservoirs the flood waters for dry seasons? In his opinion it would be a very unwise proceeding, because every one who had had anything practically to do with water impounded in large reservoirs should know that it was not of a wholesome quality for the supply of large towns. For instance, the water in Loch Katrine was, no doubt, very free from mineral matter, but it contained a considerable quantity of organic matter, and decomposing organic matter, especially in warm autumn seasons, that was unwholesome, while before it got to Glasgow from Loch Katrine a portion of the oxygen combined with a portion of the organic matter, and the water became partially de-oxidized. However, leaving that subject, he (Mr. Homersham) considered that to store water in open reservoirs and then lower it down the Thames, would be very unwise, because water standing in these artificial reservoirs became of necessity mixed with fallen leaves, faded blossoms, the droppings of animals, and other impurities, and became of worse quality even than the flowing water so contaminated. These artificial impounding reservoirs were usually made in the most barbarous manner. They often had a depth of several feet of mud and filth at the bottom, and there were no means provided for cleaning the reservoirs out, and the water became full of confervæ and living organisms; in fact, such as no water company ought to supply for domestic use. The proper way of supplying the water to the companies from the Thames would be to get at this water naturally stored in the pores of the chalk and to use it for the supply of London, which would prevent any interference with the navigation. This was being done in spite of every obstacle so unnaturally put in the way for many years past by Government. They had all read in the papers of the poisonous character of the water that had been given by the companies at different times to London, and the number of the persons who died really

* We may see on the Lea a very telling instance of the way in which money may be spent in proceedings carried out in obedience to an Act of Parliament, without producing the intended effect. It is described in the words of the Rivers Commissioners:—"By an Act passed in 1854, the New River Company obtained powers to lay down intercepting sewers through Hertford, to construct works for treating the sewage by the liming process, and to convey the effluent water past the New River head into the Lea." These works cost £2200, and £700 is paid annually to carry out the process. "The effluent water passes away clear," and being mixed with the water of the Lea, is drunk by the water consumers of the metropolis, though the people of Ware, the town immediately below Hertford, find this "clear sewage" "a constant cause of complaint." It is declared by the Rivers Commission to be sewage still, with the disadvantage of appearing to be different to what it really is.

poisoned by the water; that was due, he had no hesitation in saying, to the improper interference of the Government, or those acting under their authority, who made up Blue-Books, and had prevented new companies from supplying pure water to London. Passing on to the lower part of the Thames below Hampton, there were 600 square miles of chalk to be found forming a portion of it, and one water company (the Kent Company) had already abandoned the river and gone to that source for supply, and now supplied water from that source to 32,000 houses, or 250,000 persons, and for some time had not taken a drop of water from the river, but had gone to the chalk and obtained the water direct from wells. The New River Company also were gradually resorting to springs, or to wells sunk in the chalk. Such water at its source was of the best possible description for the purposes of a water company, being perfectly free from all organic matter, living or dead, and of one even temperature summer and winter. In the summer it was comparatively cool—52° Fahr.—while Thames and other surface water was 68° or 70°, and in winter it was about the same, when Thames water would be 33° or 34°, so that it was not liable to freeze in the pipes. The only thing which could be said against the water was that it was hard; but by a simple process, which had been in successful operation for many years, it could be reduced from 2½ degrees to 3¼ degrees of hardness. Therefore, in the interests of the health of water consumers, he hoped there would be no attempt to impound water in reservoirs on the Thames, but that the river waters should be altogether abandoned, and resort should be had at once to the natural reservoirs in the chalk for the supply.

The Rev. J. CLUTTERBUCK thought it was quite useless to make any calculations in reference to water supply founded on the average rainfalls, as the minimum only ought to be taken; and he also objected to the average which had been taken by Mr. Bailey Denton, as deduced from the observations at Greenwich. He most emphatically denied that the rainfall had decreased during the last 50 years; observations of his own for 16 years, and of others on whom he could rely for 29 years, showed rather an increase than the reverse. This seemed a principal point in the paper, and he therefore wished to remove what seemed a false assumption, which might unnecessarily frighten people. Nor did he think that anything which could be done in the way of cultivation of the land, draining, or cutting down timber, would in the least appreciable degree affect the rainfall, which was due to the Atlantic and Northern Oceans. The storeage of water in the Upper Thames might be very easily accomplished, as there was great power of storeage in the river itself. He concurred with a good deal which had been said by Mr. Homersham with reference to the springs in the chalk, and believed it might be proved that the greater portion of the water which passed over Teddington Lock at some seasons was derived from that source. If any one could see the miserable ruined inheritance on which the Thames Conservancy had entered, they would know that a great deal more money must be spent before the river could be restored to its proper condition, and one very great point gained would be the saving of the water by improvement in the navigation. With a little patience he believed they would see that they need not go elsewhere for water, but that Old Father Thames would be true to his great mission, and give them a good and abundant supply.

Mr. R. RAWLINSON, C.B., said he had listened with considerable pleasure and interest to the remarks of the preceding speaker. The amount of rainfall was dependent upon causes of so vast a character that he was perfectly satisfied that anything man could do would only modify it to an infinitesimal extent. Cultivation, clearing of land, and draining, would have but a very fractional influence on the fall of rain. Averages for even 50 years were not to be relied upon, but whether the rainfall had decreased or not, they might take it for granted that nothing they could do would influence it either for good or evil. They could, however, economize that which fell on the surface; and he might mention one fact to Mr. Homersham, which he might add to the facts which he had stored up with regard to the great gathering-grounds of chalk, which he supposed to be of such vast absorbent powers. It had been his (Mr. Rawlinson's) duty to obtain accurate observations, extending over a considerable period of time; they had been obtained by men on whom he could thoroughly rely, and the results were very surprising. Mr. Muir, of the New River Company; Mr. Greaves, of the East London Company; Mr. Beardmore, a gentleman of world-wide reputation in such matters, and Mr. James Simpson, were his informants. The Thames had been gauged accurately for a series of years over Teddington Weir by Mr. Simpson, and the daily volume of water which flowed down ascertained, with the exception of excessive floods, and those were known approximately. The other gentlemen had carried out a series of observations on the river Lea with reference to the water supply, and also for settling the legal rights of the several proprietors. The result was that, out of an average of 25 inches of rain, taking that as the datum, four-fifths of the entire volume could not be accounted for by measurement in any way, and they could only come to the conclusion that 20 inches out of the 25 passed again into the atmosphere. That result was so startling that he himself was sceptical at first until he had thoroughly investigated it. Now, as far as his investigations went, the minimum rainfall in the valley of the Thames, and also pretty generally over England, and indeed all over the world, as compared with the maximum, was as one to two, and, as Mr. Clutterbuck had said, in any calculations it was necessary to take the minimum. Now, deducting one-third from the average would give the minimum, and adding one-third would give maximum. So that, avoiding fractions, the minimum in the valley of the Thames would be about 16 inches, and maximum about 32 or 33 inches. Down to 16 inches, therefore, they must bring their calculations, and he did not suppose Mr. Bailey Denton contemplated making reservoirs for more than 365 days supply, about 120 to 200 days being generally considered sufficient by engineers. He regretted that a writer so well able, from his large experience, to handle this subject, should have used the word "compact" as describing the agreement made in the Act of Parliament between the Thames Conservators and the water companies. He did not think it was a proper word to use as applied to such a subject. He thought it rather implied that the public had been "sold" by that "compact."

The CHAIRMAN did not think the language implied that at all.

Mr. RAWLINSON said he entirely justified the demand made upon the water companies; he had had as much to do with it as any one, and if his advice had been taken the sum would have been doubled. Previously the companies had parliamentary powers to take the water without paying for it, and in the meantime the river was going to ruin in every possible way—weeds growing, channels choked up, shallows silted, all sorts of garbage allowed to be thrown in, and no scavenging whatever. The stipulation was that the Conservators should restore the river and cleanse it, so that in fact the companies had a cheap bargain of it, and the public were benefited by the transaction. With regard to the application of sewage, that also was a speciality of Mr. Denton's, but he thought a little further inquiry would teach him that sewage was clarified by a proper application to clay land, even if not underdrained, which Mr. Denton stipulated for. He (Mr. Rawlinson) by no means said the land should not be underdrained, but he could assure Mr. Denton that some persons, practically acquainted with sewage irrigation, would prefer, from their experience, to irrigate clay lands without underdraining, if Italian rye grass, which was the most profitable crop, were to be sown. In this grass the roots were near the surface, and the silica of the clay combined with the sewage, and tended to precipitate it. Experience showed that when such irrigation was judiciously carried on, although the process of assimilation did not proceed equally at all times, there was not a day in the year, winter or summer, when you could not beneficially place sewage on the land, and when that sewage would not come clarified from that land. That had been proved, and it was a very important fact. He sincerely hoped that Parliament would follow the advice given in the paper, and make sewage irrigation imperative on all towns which now tainted rivers with it; for it never would be done until the law was stringently applied. Parliament had yet to learn the immense importance of following up laws by strict supervision, so as to see that those laws which affected the whole community were effectively carried out.

Mr. HOMERSHAM said, with reference to the disappearance of four-fifths of the rainfall, that not only was he aware of that fact, but he knew a large district where it disappeared altogether.

Mr. RAWLINSON remarked that if the water disappeared from the surface, it must come out again somewhere. The only conclusion he could come to was that it was lost by evaporation.

Mr. HOMERSHAM said the water went to the sea through underground fissures, being carried off by springs below high-water mark.

Professor VOELCKER said he understood Mr. Denton to say that there were great difficulties in the way of sewage water that passed over land being perfectly purified. There was no doubt some truth in this statement, but if sewage farms were really properly managed the purification of sewage might be rendered perfect; inasmuch, however, as there were not these model establishments, and in many cases the water simply flowed *over* the land, the purification was generally very imperfect. It was far more difficult to get the water through the soil than was generally believed, especially on clay lands, where it often ran through the cracks, and did not actually go through the soil at all. Where properly managed, however, sewage water, after passing through the soil, became quite fit for ordinary uses and for drinking. There was one other purely chemical question on which he would make an observation—the organic matter in water. The writer of the paper thought it would be desirable to have a fixed standard for the amount of organic matter which should be present in water for drinking, and Mr. Homersham said that some water was perfectly free from these matters. Chemically that was not correct, as no natural water was absolutely free from organic matter, although to a non-chemical eye it might appear so. He thought it would be desirable to have something like a standard of purity, but, without knowing the kind of water, it would be extremely dangerous to fix such a standard. He had had water for analysis which contained very little organic matter, and yet which he had no hesitation in pronouncing totally unfit for drinking, whilst other samples, which contained three or four times as much organic matter, were useful and wholesome. It was not so much the amount as the quality of the organic matter which was of importance, and hence the difficulty of fixing the standard by quantity. In practice, a very good test of the presence of injurious matter was to bottle off a portion of the water for a fortnight or three weeks, and then examine it, when, if the organic matter, however small in quantity, were in a state of decomposition, there would be an unpleasant smell. This was perhaps as good as any chemical test which could be applied. There were great difficulties in estimating with precision the quantity of nitrogen, as suggested by Professor Frankland. If that could be done it would be a step in advance, but as that could not be done, there would be very great difficulty in fixing a standard for the amount of organic matter which might be tolerated in drinking water.

Mr. BOTLY, in explanation of a discrepancy between the amount of rainfall as stated in the report of the Royal Agricultural Society and that given elsewhere, stated that the reports were issued a considerable time after date. He also remarked, in reference to the cultivation of Italian rye grass, that where it was attempted without sewage irrigation, the soil was very much exhausted, in some cases causing the total failure of the succeeding crop.

Mr. NEATE, M.P., wished to call attention to what had been said by Mr. Homersham, which had made a considerable impression on his mind, about the unwholesomeness of water which had been stored. He had been one of those who had attached great importance to the storeage of water in the valley of the Thames, but it now appeared from what had been said that this would be of very little value, because the water would not be wholesome. He thought this would much depend, however, on the way in which the water so stored was kept up. Was it to be merely by the overflow of the water in the river, or by the turning into it of streams in the summer season? If it were kept up in that way, what advantage would be gained by turning those streams into reservoirs which would not be gained by turning them into the river itself? Mr. Homersham seemed to value the great chalk reservoirs, not so much by what they gave out as by that which they kept in. They all knew, however, that there was an immense amount of water in these chalk reservoirs, but its only value was when it was released therefrom.

Mr. TOWLE gave his opinion in favour of reservoirs, and remarked that it would be no new thing, there having been in the neighbourhood of Standlake and other places above Oxford (until draining and other agricultural works had destroyed them), immense natural reservoirs, which served to feed the stream in summer seasons, and which he, as a miller, now felt the want of very much. He also thought that better regulations for ensuring a perfect flow and scouring of the river would be very beneficial.

Mr. BAILEY DENTON, in reply, said that he had carefully avoided referring to what was known as his own scheme, or the project with which his name was connected, which was the utilization of the upper streams of the Thames in connexion with storeage. That would explain the omission of many details, as Mr. Homersham and Mr. Rawlinson would understand. The same explanation would apply to Mr. Clutterbuck's remark that averages of rainfall had very little to do with the question. He had himself frequently stated (he believed in that room) that the minimum rainfall was the real basis to be taken. With regard to the exception which had been taken to the use of the word "compact," he thought he could hardly have chosen a word less liable to an offensive interpretation; but, if it was thought desirable he would withdraw it, and substitute the term "agreement" or any other term that might be preferred. Mr. Rawlinson's authority stood as high as that of any man in relation to the question of irrigation by sewage, but if he had understood him aright in saying that the drainage of such land was not necessary, he must, with the greatest respect, give a contradiction to such a statement. He considered it absolutely essential. With regard to the storeage of water, he did not say that such reservoirs as Mr. Homersham had referred to would not be objectionable, but he had not at all gone into the question of what reservoirs would be desirable, if it were necessary to supply London direct from reservoirs. The whole of his observations on that and former occasions had tended towards conserving

in winter the surplus water, in order to compensate the river in summer for what was taken out of it, the water not being supplied direct to the consumers from the reservoirs, but returned to the river. That, perhaps, would satisfy the gentleman (Mr. Neate) who wished him to refer to that point. At the same time he must not be understood to hold that reservoirs could not be constructed in the valley of the Thames, in which water might be preserved for drinking purposes. He believed they knew very little about what might be done in that way, if there were proper means adopted for purifying the water, and that the conservation of water in large reservoirs of sufficient depth, would tend to improve its quality rather than to injure it.

The CHAIRMAN, in proposing a vote of thanks to Mr. Denton, said, that of course anybody with the experience of Mr. Homersham or Mr. Rawlinson could have added a great deal to the paper, and so could the writer himself had he not been restrained by the time at his disposal. It seemed to him that the paper had brought before them the prominent question on which the public must pronounce a decision before long. As to the question of the rainfall, he quite agreed with what Mr. Rawlinson had said, but that, after all, was a secondary consideration. The operations of nature were conducted on so vast a scale that anything man could do would not produce any perceptible effect, but still he should be very sorry if the local observations which had been conducted with such great care were discontinued, because they were of very great value. If, however, they were told that improved drainage increased the floods and the droughts, he said these questions were not worth a moment's consideration with reference to the great question of the supply of water to the river. They who knew what took place in the north and west of England, especially in the mountain districts, knew very well that it was the great mass of water brought from the ocean to which they looked; and although the rain was largely absorbed before it came to this more southern locality, still it was practically to that source that we must look for a supply of water. Therefore, although it was very wise to make these observations, for all practical purposes they might be disregarded. He was reminded by this discussion of the answer which a celebrated engineer gave to the question of what use rivers were. He said their only use was to supply canals. So, in relation to this question, he should say that the use of valleys was to store water. He believed that there was an unbounded supply for the wants of man if they took the minimum water supply of any district, which, as had been said, might be taken at 16 inches; if all that were stored it would be abundant for generations to come. He believed, from what he had heard in the course of professional experience—for he had no practical acquaintance with the subject—that water stored in large bulk was improved in quality. Where it was stored in small bulk and in shallow depths it might become impure, but in larger quantities it was different. The observations of Mr. Homersham on the way in which water was stored in the chalk were most interesting, but, if this could not be got at, it was evidently wise to store what could be conveniently got at in the valleys. He would only say one word with reference to what Mr. Rawlinson had said on the question of the "compact." He thought the arrangements then made were very advantageous and desirable. If the water companies obtained large quantities of water from the river, which was to be brought into a proper condition, it was only right that they should contribute to the maintenance of that from which they derived this benefit. There was one larger question still in which many were interested—viz., the right of rivers to the watershed of the district. They had had that before them on a recent occasion, with reference to the drainage of the Fens. There the water of the district had become essential to the maintenance of the rivers if navigation were to go on. In modern times, however, the question of navigation had become of less importance than drainage, although in an earlier stage of civilization it might not have been so. Now that the main traffic of the country was carried on by means of railways—navigation, drainage, and water supply ought all to be kept distinct. The time was not far distant when, as they had seen with reference to the watershed of the Thames, the inhabitants of particular districts would become extremely jealous of water being transferred from one watershed to another. A river had a right to the water naturally belonging to it, and the inhabitants of the district had a right to the use of it; but, inasmuch as they benefited from that very use, why should they not be taxed for the maintenance of it in a proper condition? Those were questions upon which we were just entering; and he believed that the paper they had heard was one great step towards the solution of them. Those who knew what the state of the Thames was some years ago, when old London Bridge existed, and Lambeth was supplied with water drawn from the river between Waterloo and Westminster Bridges, would see that anything which was paid for the privilege of drawing the water from beyond the tidal influence was money equitably levied. Tidal influence was, in fact, created by the removal of old London Bridge; and there being now a totally new state of things, the money paid for their advantage was rightly paid, for a good supply of water to the metropolis could not possibly be bought at too high a price.

DEATH OF D. METHVEN, ESQ.—On the 13th inst., at 13, Stock Orchard Villas, Holloway, in his 49th year, David Methven, Esq., for 14 years engineer to the St. Pancras station of the Imperial Gas Company, London, deeply regretted.

DR. WHITMORE'S REPORT ON THE QUALITY OF THE GAS SUPPLIED IN ST. MARYLEBONE, IN JUNE, 1867:—

JUNE.	Illuminating Power in Sperm Candles.			Mean Pressure in 10ths of an inch.	
	*Mean of 24 Observations.	Highest.	Lowest.	Highest.	Lowest.
Imperial Company's gas	14·38	15·34	13·71	27·91	8·22
Chartered Co.'s common gas . .	12·86	14·13	12·18	32·30	11·88
Chartered Co.'s cannel gas . . .	21·72	22·98	20·48	28·60	9·96

* Each observation consists of 10 readings of the photometer.

On no occasion during the month of June did the illuminating power of the three gases supplied to the parish fall below the legal standard; that supplied by the Imperial Company gave a mean of 14¼ sperm candles, twice it exceeded 15 candles, and on four occasions only did it fall below 14 candles. The common and cannel gases of the Chartered Company maintained a mean light which exceeded the standard to a satisfactory extent, and on several occasions reached an excess of nearly 3 candles. The pressure of all the gases was good, and the sulphur impurity always less than the law permits. The above results are obtained from the gas manufactured by the Imperial Company at their Fulham works, and from the Chartered Company's gas, manufactured at their works, Horseferry Road, Westminster.

DR. WHITMORE'S REPORT ON THE QUALITY OF THE WATER SUPPLIED IN ST. MARYLEBONE, IN JUNE, 1867:—

JUNE.	Total Solid Matter in degrees or grains per Imperial gallon.		* Loss by Incineration of Solid Matter in previous column.		Ammonia.
	June, 1866. 0°	June, 1867. 0°	June, 1866. 0°	June, 1867. 0°	0°
Distilled Water . . .					
West Middlesex water	17·28	18·40	0·60	0·48	—
Grand Junction water	17·72	18·34	0·73	0·60	—

* The loss by incineration represents the amount of organic and other volatile matters contained in an Imperial gallon (70,000 grains) of water.

The reduced amount of organic matter found in the water supplied to the parish during the month of June by the two Thames companies is, to some extent, attributable to the dry weather, but it shows also the great care taken in the process of filtration, and the efficiency of the means employed. The above results give the mean of two analyses taken at the close of the first and third week, the water being always taken direct from a stand-pipe, and may therefore fairly be considered as indicating the condition of the water during the entire month. At no period within my recollection has the water supplied to this extensive parish been better or purer than it is now, and in the anticipation of a possible return of cholera during the autumn, a knowledge of this fact must assuredly be both gratifying and reassuring.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATERS, IN JUNE, 1867.—The following are the returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Tot. solid Matter per gal.	Loss by Ignition*	Oxidizable Organic Matter.†	Hardness.	
				Before Boiling.	After Boiling.
Thames Water Companies.	Grains.	Grains.	Grains.	Degrees.	Degrees.
Grand Junction	19·83	1·00	0·58	12·0	4·5
West Middlesex	19·50	0·99	0·51	11·5	4·5
Southwark and Vauxhall . .	20·67	1·25	0·64	13·5	4·5
Chelsea	20·00	1·18	0·82	12·0	4·5
Lambeth	19·42	1·46	0·68	13·5	4·5
Other Companies.					
Kent	27·00	0·50	0·04	16·5	7·0
New River	18·44	0·73	0·45	12·0	5·0
East London	19·60	0·87	0·56	12·0	5·0

HY. LETHEBY, M.B.

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxidizable organic matter is determined by a standard solution of permanganate of potash—the available oxygen of which is to the organic matter as 1 is to 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube 2 feet in length and 2 inches in diameter.

DR. FRANKLAND'S ANALYSIS OF THE METROPOLITAN WATERS IN JUNE, 1867.—"Royal College of Chemistry, June 29, 1867.—Sir,—I have the honour to submit to you in the following table the results of the chemical examination of the waters supplied to the metropolis during the month of June. For the purpose of comparison, I append also the results yielded by Loch Katrine water, as supplied to Glasgow, when submitted to the same analytical processes:—

Companies.	Date and Place of Collection.	Total Solid Impurity in 100,000 Parts.	Organic Carbon.	Nitrogen, as Nitrates and Nitrites.	Ammonia.	Total combined Nitrogen.	Previous Sewage Contamination (Estimated).	Total Hardness.
Thames.								
Chelsea.....	June 1—Cab Rank, Horse Guards ...	28·28	·261	·214	·004	·217	1158	20·3
West Middlesex	June 1—Cab Rank, Portland Road...	27·22	1·020	·218	·120	·421	2195	19·4
Southwark & Vauxhall..	June 14—Barclay's Brewery	20·70	·231	·170	·002	·172	735	20·9
Grand Junction.....	June 24—R. Coll. of Chemistry	28·42	·265	·204	·004	·207	1085	20·9
Lambeth	June 3—Cab Rank, Westminster Rd.	28·18	·325	·220	·001	·220	1305	20·9
Other Sources								
New River ..	June 1—Havstk. H.	23·12	·217	·198	·001	·199	1005	16·3
Do., filtered through animalcharcoal.	Do., do.	21·02	·071	·156	·004	·159	605	12·3
East London.	June 21—Old Ford Water-Works ...	27·22	·237	·150	·002	·152	535	19·7
Kent.....	June 13—Wr-Wks. Deptford.....	39·04	·165	·320	·001	·321	2225	28·3
Loch Katrine	Feb.—Glasgow ...	3·28	·256	·031	·002	·041	0	0·3
Column 1	2	3	4	5	6	7	8	9

The numbers in columns 3, 4, 5, 6, 7, 8, and 9 all relate to 100,000 parts of the waters. The table is to be read thus: 100,000 lbs. of Chelsea water collected on June 1 at the Horse Guards cab rank contained 28·28 lbs. of solid impurity; the organic matter, constituting a portion of this impurity, contained ·261 lb. of carbon. This solid impurity also contained ·214 lb. of nitrogen in the form of nitrates and nitrites, besides ·004 lb. of ammonia; whilst the total amount of *combined* nitrogen in every form was ·217 lb. The above quantity of water supplied by the Chelsea Company had been, after its descent to the earth as rain, contaminated with sewage or manure matter equivalent to 1158 lbs. of average filtered London sewage. By gradual oxidation, partly in the pores of the soil, partly in the Thames or its tributaries, and partly in the reservoirs, filters, and conduits of the company, this sewage contamination had been entirely converted into comparatively innocuous inorganic compounds before its delivery to consumers. Finally, 100,000 lbs. of the Chelsea Company's water contained 20·3 lbs. of carbonate of lime, or an equivalent quantity of other soap-destroying ingredients. The above analytical results show that the water of the West Middlesex Company, drawn from the stand-pipe at the cab rank in Portland Road, on

the 1st inst., was contaminated with sewage (*present* sewage contamination), for, if the amount of nitrogen existing as nitrates, nitrites, and ammonia (·318 part) be deducted from the total combined nitrogen, there remains ·103 part, which must be *organic* nitrogen, equivalent to 1030 parts of average London sewage in 100,000 parts of the water, or rather more than 1 per cent. The water was turbid when drawn, and, after standing for a few days, emitted a very offensive odour, and became filled with white flocculent matter, resembling that which gradually deposits from filtered sewage. A few days later this odour disappeared. In answer to my inquiries, the engineer of the company informs me that a breakage had occurred in one of the company's mains in an adjoining street, and near a gully-hole. This fracture, which was repaired on the 3rd of June, soon after its discovery, happened to a main from which the water pressure was removed at night, and it is believed that, during this absence of pressure, sewage commingled with the contents of the main. It is gratifying to find this satisfactory reason for believing that this contaminated water was delivered to a small district only, and for a short time; but this accident supplies another item to the already long list of dangers attending an intermittent supply of water. On the *constant* system no sewage contamination arising from such a cause could occur. On taking a sample from the same source, on the 7th inst., I found the water restored to the usual condition of normal Thames water. The water of the Southwark Company, when drawn from the main, was turbid; and that of the East London Company very slightly so.—I have, &c., E. FRANKLAND. —The Registrar-General, &c."

Share List of Metropolitan Gas Companies.

No. of Shares issued.	Amount per Share.	Name of Company.	Amount paid up per Share.	Div. per Cent. per Annum	Price per Share.
	£		£ s d	£ s d	£ s d
8000	10	Anglo-Romano . .	10 0 0	9 0 0	11 to 12
5000	20	Bahia (Limited) . .	20 0 0	nil.	16 10 0
1000	20	Do., preference .	20 0 0	10 0 0	27 10 0
750	20	Do., do., redeem.	10 0 0	10 0 0	12 10 0
40000	5	Bombay (Limited) .	5 0 0	5 0 0	4½ to 4¾
10000	5	Do., third issue .	3 0 0	5 0 0	3½ to 3⅝
10000	20	British, Limited (Norwich, Hull-Sculcoates, Hanley, Tunstall & Shelton [Potteries], Trowbridge, & Holywell.)	20 0 0	6 0 0	28 to 29
12000	50	*Chartered*	50 0 0	8 10 0	53 to 54
6000	50	Do.	35 0 0	8 10 0	37 to 38
10000	20	*City of London*, A shares	20 0 0	8 0 0	23 to 25
10000	10	Do., B shares	10 0 0	4 0 0	6½ to 7
8000	10	Do., new shares.	10 0 0	8 0 0	11½ to 12¾
25000	25	City of Moscow (L)	25 0 0	£7 intr.	15¼ to 16
17490	25	*Commercial* . . .	25 0 0	10 0 0	31 to 33
2500	20	Continental Union.	20 0 0	8 0 0	12 to 14
17500	20	Do.	15 0 0	8 0 0	9 to 10
10000	20	Do., preference .	20 0 0	7 0 0	
5827	5	County & Gen. (L)	5 0 0	nil.	
2000	5	Do., preference . (Pater, Pembroke, Ely, Lea Bridge, Northfleet, Walton, & Ware.)	5 0 0	nil.	
5000	10	*Crystal Pal. Dist.*	10 0 0	10 0 0	13 to 14
5000	10	Do., preference .	10 0 0	6 0 0	12½ to 13
10000	10	Do.	2 10 0	7 0 0	2¼ to 3
4000	50	*Equitable*	50 0 0	10 0 0	65 to 66
4000	25	Do., new shares.	25 0 0	10 0 0	33 to 34
23406	10	European (Lim.) .	10 0 0	10 0 0	12½ to 13½
12000	10	Do., new shares. Boulogne, Amiens, Rouen, Caen, Havre, & Nantes.)	5 0 0	10 0 0	6½ to 6¾
20000	10	*Gt. Cent. Gaz Cons.*	10 0 0	10 0 0	12½ to 13
5000	10	Hong Kong (Lim.)	10 0 0		8 to 10
26000	50	*Imperial*, old sh.	50 0 0	10 0 0	63 to 64
1300	100	Do., bonds . . .	£100	10 0 0	170 to 172
2391	25	Imperial Austrian.	25 0 0	nil.	
28000	50	*Impl. Continental* (Amsterdam, Berlin, Ghent, Hanover, Lille, Rotterdam, Aix-la-Chapelle, Antwp., Bordeaux, Brussels, Cologne, Frankfort-on-M., Haarlem, Stolberg, Toulouse, & Vienna	43 15 0	16 0 0	95½ to 96¼
400	100	Impl. Mexican (L.)	75 0 0		
3000	40	*Independent* . . .	40 0 0	10 0 0	50 to 53
3000	10	Do.	10 0 0	5 0 0	7 to 9
3000	20	Do.	12 10 0	7 10 0	13 to 14
7133	50	*London*	50 0 0	10 0 0	62 to 63
5610	25	Do., 1st pref. .	25 0 0	6 0 0	25 to 26
503	50	Do., 2nd pref. .	50 0 0	6 0 0	
214	50	Do., 3rd pref. .	50 0 0	6 0 0	
187814		Do., 1st pref. sh		6 0 0	
118287		Do., 2nd pref. sh		5 0 0	
12000	5	Malta & Medit. (L.)	5 0 0	4 0 0	3¼ to 4
6000	5	Do., preference .	5 0 0	7 0 0	5 0 0
30000	5	Oriental, Calcutta	5 0 0	8 10 0	5⅛ to 5⅜
30000	5	Do., new shares.	1 0 0	8 10 0	1 to 1⅛
10000	5	Ottoman (Limited)	5 0 0	nil.	1⅛ to 2⅛
10000	10	Parà (Limited) . .	10 0 0	6 0 0	9¼ to 9⅜
27000	20	*Phœnix*	20 0 0	10 0 0	26 to 26½
3600	100	Do., new	25 0 0	7 10 0	24½ to 25½
144000	Sk.	Do.	100 0 0	5 0 0	70 to 71
5000	20	*Ratcliff*	20 0 0	10 0 0	22 to 24
	20	Rio de Janeiro (L).	20 0 0	10 0 0	21¼ to 22½
6959	5	Singapore (Lim.) .	5 0 0	3 10 0	
2000	5	Do., preference . Shanghai	5 0 0	7 10 0	
4800	50	*Sth. Metropolitan*	50 0 0	10 0 0	70 to 71
15000	10	*Surrey Consumers*	10 0 0	9 0 0	12½ to 13
10000	10	Do., new	5 0 0	9 0 0	7 to 7¼
9000	4	United General . . (Limerick)	4 0 0		
1000C	10	*Victoria Docks* . .	5 0 0	6 0 0	
3000	10	*Wandsworth & Putney*	10 0 0	7 10 0	13½ to 14
20000	10	Western (L.) A sh.	10 0 0	10 0 0	18½ to 14
10000	10	Do., B shares.	5 0 0	10 0 0	6¾ to 7
10000	10	Do., C shares.	5 0 0	10 0 0	6¾ to 7
20000	10	Do., D shares.	1 0 0	10 0 0	1¼ to 2
8000	5	*West Ham*	5 0 0	7 10 0	6 10 0
6000	5	Do., new shares.	3 0 0	7 10 0	3 18 0
551	10	West London Junction (Lim.) . .	10 0 0	6 0 0	
520	10	Do., preference .	10 0 0	6 0 0	

Price Current.

CASTINGS.—*Per Ton.*

Average Weight of Cast-iron Gas-pipes, per Yard.

1¼ in.	2 in.	2½ in.	3 in	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.
16	21	28	33	51	70	89	107	126	149	177	208 lb

Retail Prices are 5 to 10 per cent. higher.	London.	Glasgow.	Newcastle	Wales.	Yorkshire, Derbyshire, and Staffordshire.
	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
Pig Iron, No. 1 (g.m.b.)	3 15 0	2 14 0	2 12 6	3 10 0	3 10 0
1¼ and 2-inch Socket-pipes	7 10 0	6 0 0	6 15 0	6 15 0	7 10 0
2½ and 3-inch ditto	7 0 0	6 0 0	6 5 0	6 10 0	7 0 0
4 and 5-inch ditto	6 10 0	5 10 0	5 15 0	6 0 0	6 10 0
6 inches and upwards ditto	6 5 0	5 0 0	5 10 0	5 15 0	6 5 0
Retorts, 1st fusion, hot blast	6 0 0	—	5 5 0	5 10 0	6 0 0
Ditto, 2nd ditto, cold ditto	7 0 0	5 15 0	5 15 0	6 0 0	7 0 0
Tank-plates, ¼ thick and above	6 10 0	5 10 0	5 10 0	5 15 0	6 5 0

WROUGHT-IRON TUBING,

Subject to 50 per cent. Discount.

	2 in.	1¼ in.	1½ in.	1 in.	¾ in.	½ in.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Patent Welded Tubes, from 2 to 12 feet—per foot	1 8	1 0	0 10	0 7	0 5	0 4½
Ditto ditto, from 6 inches to 18 inches—each	3 0	2 0	1 9	1 3	1 0	0 9
Connecting-pieces, or Long Screws	3 6	2 3	2 0	1 6	1 2	0 11
Bends, Springs, and Elbows (wrought iron)	3 9	2 3	1 9	1 0	0 10	0 8
Tees, wrought or cast	4 0	2 6	2 0	1 6	1 1	0 10
Crosses, ditto	4 6	3 0	2 6	2 0	1 6	1 2
Iron Cocks	17 6	9 6	7 6	4 6	3 3	2 6
Ditto, with brass plug	28 0	16 0	13 0	7 0	5 6	4 6
Diminishing Sockets, Caps, Plugs, and Nipples	1 3	0 9	0 8	0 6	0 5	0 4
Plain Sockets	1 0	0 8	0 7	0 5	0 4	0 3
Syphons, 2-quart	15 0	14 0	13 6	13 0	12 0	—

GAS COALS.—*Per Ton.*

Newcastle.—Unscreened:—

East Castle, Haswells, Nettlesworth Primrose, and South Pelaw	7s. 6d.
Felling, North Pelton, Redheugh Main, Walker's Primrose, West Wear, and Whitwell Primrose	7 9
Burnhope, Craghead, Charlaw, Derwent, Edmondsley, Eighton Moor, Hartlepool Pelaw, Holmside, Lambton's Gas, Lanchester Pelaw, Medomsley, Mickley, New Pelaw, Pelaw Main, Ravensworth, South Moor Pelton, South Leverson, Townley Main, Tyne Main, West Pelaw, Wearmouth Hutton, and Witton	8 0
Pearth, Ravensworth Pelaw, Waldridge, West Garesfield, and West Pelton	8 3
Brancepeth, Dean's Primrose, New Pelton, Pelton, South Pearth, Stella, Urpeth, Washington Hutton, and West Leverson	8 6
Ramsay's Newcastle Cannel	20 0
Wigan Cannel (at Liverpool)	17 0
Scotch Cannel:—	
Boghead (at Leith)	55 0
Kirkness, best (at Burntisland)	28 6
Capeldrae, 1st quality (at ditto)	28 6
Ditto, 2nd ditto (at ditto)	18 6
Cowdenbeath	12 0
Lesmahago (at Glasgow)	32 6
Ditto (at Granton)	30 0
Arniston	27 6
Wemyss	20 0
Haywood, Wilsontown (at Granton)	23 0
Pirnie, or Methill	15 0
Lothian's Cannel (at Leith)	28 0
Myles' Cannel	23 6

FREIGHTS.

Coastwise—Newcastle.—Per Ton:—

Chatham and Rochester	5s. 9d to 6 0d
Cork	9s. to 9 6
Dover, Folkestne, & Ramsgate	6 3
Dublin	9s. 6d. to 10 0
Exeter Quay	8 6
Ipswich	5 0
London (from Leith)	8 0
London (Pool)	6 0
Lowestoft and Yarmouth	4 6
Portsmouth & Southampton	7 0
Plymouth	7 9
Shoreham	6 9
Whitstable	5 9
Weymouth	7 6
Foreign.—Per Keel:—	
Barcelona	£19 10
Bordeaux	13 10
Boulogne and Calais	7 0
Cadiz	£14 to 14 10
Cronstadt	—
Copenhagen	8 0
Genoa	16 0
Hamburg	7 10
Havre de Grace	8 10
Leghorn	£16 to 16 10
Lisbon	14 10
Rotterdam	£7 to 7 6
Stettin	£8 10s. to 9 0
Trieste	16 0
Venice	19 10

SUNDRIES.

Best Natle. Fire-bks., p. 1000, £2 10s. to £3	15 0
Cliff's Fire-bks. (at Wortley), p. 1000.	2 15 0
Ingham's ditto (at Wortley), p. 1000.	2 15 0
Fire-clay Retorts, p. ft. run, 5s. 6d. to	0 7 0
Tough Cake Copper, p. ton	79 0 0
English Pig Lead, p. ton	19 15 0
Welsh Bar Iron (in London), p. ton	6 10 0
Foreign Spelter, p. ton	21 0 0
English Block Tin, p. ton	91 0 0
Banca, p. ton	93 0 0
Tarred Rope Yarn, p. cwt.	1 0 0

Advertisements.

LIVESEY FIRE-CLAY WORKS,

NEAR BLACKBURN, LANCASHIRE.

ORLANDO BROTHERS,

MANUFACTURER OF PATENT CLAY RETORTS,

AND EVERY DESCRIPTION OF

TUBULAR GLAZED SEWERAGE PIPES, BENDS, JUNCTIONS, ETC.

FIRE-BRICKS, TILES, BLOCKS, AND CHIMNEY-TOPS.

JOHN VICKARY,

GAS ENGINEER AND CONTRACTOR, IRON AND BRASS FOUNDER,

WORKS—EXE ISLAND, EXETER,

Tenders his best thanks to the various Gas Companies in **England, Ireland, and Wales,** for the very liberal and kind support he has received for the last **22 years,** during which period he has erected and extended above **200 Gas-Works.**

In addition to the numerous towns wherein he has been engaged, he begs reference to the following testimonial:—

Plymouth and Stonehouse Gaslight and Coke Company.

Sir,—I have much pleasure in testifying that the 100-foot Telescope Gasholder and Cast-Iron Tank, erected by you for this Company in 1862, has given the highest satisfaction, and never required the slightest attention or adjustment since its completion.

(Signed) PETER ADAMS, Chairman.

He has also erected a 100-foot Gasholder and Cast-Iron Tank at **Exeter;** an 80-foot Telescope Gasholder and Iron Tank at **Devonport;** a 90-foot at **Torquay,** &c. &c. At either of those works satisfactory references can be made.

He also begs particular attention to his **Improved Gas-Meters,** either **Wet, Dry, or Compensating,** the materials and workmanship of which guaranteed of the very best description, and which has gained for his Meters so excellent a reputation for these last **20 years.**

RETORTS, DIP & ASCENSION PIPES, HYDRAULIC MAIN, CONDENSERS, PURIFIERS, STATION-METERS, GOVERNORS, VALVES, and GASHOLDERS,

Of any size, and every description of article required in Gas-Works.

Mains, Tees, Connexions, and Syphons, from 2 to 12 in., always in stock, and supplied at Scotch prices.

Clay Retorts and Fire-Goods of every description.

Gas-Fittings of the most modern designs.

Iron Pipe and Fittings, Service Cocks, &c.

Plans, Specifications, and Estimate for the erection of New Gas-Works of any size furnished.

LEAKAGE REDUCED

BY THE USE OF

CATHELS'S PATENT

DRY DISTRICT GOVERNOR.

Gas Companies supplying districts with varying levels can, by the use of this Governor (which is entirely new in principle), assimilate the pressures in the higher to that in the lower levels, and so materially reduce their leakage accounts. It is self-acting, simple, and certain, *increasing and reducing the pressure as required.*

Prices and particulars furnished on application to

MESSRS. GUEST & CHRIMES, FOUNDRY & GENERAL BRASS-WORKS, ROTHERHAM.

EDWARD COCKEY & SONS,

IRON-WORKS, FROME SELWOOD,

PATENT GAS-VALVES.

A PRIZE MEDAL

WAS AWARDED TO THE PATENTEES AT THE INTERNATIONAL EXHIBITION OF 1862.

These Valves are formed of two cylinders, working one on the other horizontally, having their faces ground perfectly gas-tight.

They are adapted either as central valves, for two, three, or four purifiers—as bye-passes—or as inlet and outlet-valves for gasholders.

They have been fixed in some of the most important Gas-Works in the Kingdom, for more than eight years. Considerably over two hundred of them are now in use, and the most satisfactory reports of their advantages continue to be received. They are simple in construction, and not liable to get out of repair, and if in course of time the faces should leak, they can be easily re-ground and made as tight as ever, without removal from their positions. Each Valve is fitted with an index, which shows to the person in charge of the Works in what direction the gas is passing.

Frome, January 20, 1866.

WILLIAM & BENJAMIN COWAN,

(ESTABLISHED 1827,)

WET AND DRY

GAS-METER MANUFACTURERS,

BUCCLEUCH STREET WORKS, EDINBURGH.

WANTED, by an experienced young Man, age 23, a Situation as METER PROVER. Good references can be given.
Address J. A. F., 151, Albany Road, CAMBERWELL, S.

WANTED, an active Man used to SMITH-WORK, and to lay services and fix meters. Also to make himself generally useful on the works.
Also a good STOKER, to attend to steam-engine and exhauster. None but steady men of good character need apply.
Address H. G. C., care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a good, steady, respect- able man to take charge of the gas-works, and make gas for lighting a nobleman's mansion. He must be a gas-fitter. As there will be no gas made during summer, it is desirable for him to fill up his time with driving an engine.
Apply to Messrs. C. and W. WALKER, Donnington, Newport, SHROPSHIRE, per letter, stating age and references.

WANTED, to go abroad, a good BRASS-TURNER, who understands renovating gas-fittings, repairing old work, lacquering, &c. Satisfactory references as to sobriety, steadiness, and industry should be given, and applications, stating age and where employed, addressed to FIELDEN BROTHERS, Peel Street, MANCHESTER.

WANTED, 1 set of good second-hand 6-in. to 10-in. CONDENSERS.
Apply, stating particulars, with price, to the Milnrow Gas Company, near ROCHDALE.

WANTED employment, by a first- class MAIN-LAYER and erecter of Gas-Works.
Address A. B. (Babbs'), 71, Paradise Street, ROTHERHITHE, S.E.

TO GAS-WORK MANAGERS.

WANTED, a Working Manager for the Gas-Works at St. Ives, Cornwall. The person appointed must be capable of setting retorts, and generally to do the repairs of a gas-work. He must have had the management of similar works, and be able to provide security. Wages 23s. per week, with house, coal, and light free.
References and application to be made to the Owner, GEO. BOWER, St. Neots, Hunts.

FOR SALE, 2 sets of 4 Cast-Iron Dry- Lime PURIFIERS, 15 ft. by 11 ft., and 3 ft. deep, with hydraulic centre-valves for 12-in. connexions and malleable iron trays.
Also 2 Cast-Iron Dry-Lime PURIFIERS, 14 ft. by 8 ft. 8 in., and 3 ft. deep, with wood trays.
The above are being sold in consequence of larger ones being substituted, and may be seen by applying to J. ARNOTT, the Leeds New Gas-Works, Meadow Lane, LEEDS.
Leeds, July 19, 1867.

TO GAS COMPANIES AND ENGINEERS.

FOR SALE.—A Good Cast-Iron Tank, in excellent condition, 45 feet diameter, 14 feet deep, either with or without Gasholder.
Also the following STATION-METERS:—

One	to pass	12,000	cubic feet	per hour.
One	"	8,000	"	"
One	"	4,000	"	"
Two	"	3,000	"	"

The whole have been taken apart, thoroughly examined, and are in good working order, equal to new.
The above have been taken down to make room for larger.
Apply to JOHN VICKARY, Gas Engineering Works, EXETER.

BALANCE-SHEETS AND REVENUE ACCOUNTS.

A FIRM of Accountants, much engaged in the preparation of Gas Companies Accounts, are open to contract for the keeping, balancing, or auditing the books of other Companies, which, from their experience, they are enabled to do on moderate terms.
Address, SANDELL & MADDERS, Accountants, 4, Skinner's Place, Size Lane, LONDON, E.C.

GAS TAR.

THE Directors of the Dorchester Gas and Coke Company are prepared to receive TENDERS for the surplus TAR produced on their works for one or two years from the 1st day of August next.
The Directors will deliver the Tar into Contractor's tank at the London and South-Western or Great Western Railway Stations.
The Directors do not bind themselves to accept the highest or any tender.
Tenders to be sent in on or before the 29th inst.
WILLIAM OSMOND, Manager.
Gas-Works, Dorchester, July 20, 1867.

TO GAS-WORK CONTRACTORS.

THE Llantrissant Gas Company are prepared to receive TENDERS for the erection of a complete GAS-WORK, and for laying Main Pipes and Services according to plans and specifications prepared by their Engineer, Mr. George Bower, of St. Neots.
Plans and specifications may be seen on and after Monday, the 29th July, at the Offices of the Company's Solicitor at Pontypridd, and also in London on application to the Engineer.
Tenders for the whole works must be delivered on or before the 12th of August at noon, at the Office of the Solicitor of the Company, E. SPICKETT, Esq., Pontypridd, GLAMORGANSHIRE.
The Company do not bind themselves to accept the lowest or any tender.

TO CONTRACTORS & GAS ENGINEERS.

THE Colchester Gas Company will shortly have to dispose of the following WORKING PLANT now used in the construction of a New Gasholder Tank—viz.:
1 8-horse power (Clayton and Shuttleworth's) Portable Engine.
1 12-in. (Owen's) Double Pump and Gearing.
1 6-in. (Gwynne's) Centrifugal Pump.
All the above are nearly as good as new.
Several lots of good red deals, planks, and battens; wrought-iron ballast skips, buckets, &c., &c.
Full particulars of the above will be given by applying to Mr. A. C. FRASER, Engineer to the Colchester Gas Company, COLCHESTER.

TAR & AMMONIACAL LIQUOR FOR SALE.

THE Directors of the Blackburn Gas- light Company are prepared to receive TENDERS for the purchase of all the TAR and AMMONIACAL LIQUOR to be produced at their works between the 1st of January, 1868, and the 30th of June, 1869.
Printed conditions and other information may be obtained from Mr. O. BROTHERS, the Company's Engineer, by whom tenders in writing will be received until the 1st of August next.
Gas-Works, Blackburn, June, 1867.

BOROUGH OF FAVERSHAM.

TO SEWER CONTRACTORS, EXCAVATORS, AND OTHERS.

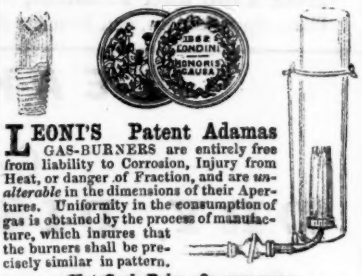
THE Town Council of the borough of Faversham will MEET in the Town Hall on Monday, the 29th day of July now inst., at Seven o'clock in the evening, and will be then prepared to open TENDERS for the construction of about 1370 yards run of 25-in. by 18-in. oval, glazed, socket DRAIN-PIPE SEWER, and 728 yards run of 12-in., and 343 yards run of 9-in., tubular Drain-Pipe Sewers for the drainage of the eastern part of the borough, with man-holes, gullies, and other works in connexion therewith.
Plans, sections, specifications, and conditions may be seen and form of tender obtained at the Town-Clerk's Office, and other particulars may be had on application to Mr. Thomas Ware, the Surveyor of the Sewer Authority.
Tenders must be sealed, endorsed "Tender for Eastern District Sewerage," and must be delivered at the Town-Clerk's Office before Four o'clock on the above-named day.
The Council do not bind themselves to accept the lowest or any tender.
By order,
SAMUEL G. JOHNSON, Town-Clerk.

GAS OF HIGH ILLUMINATING POWER.

THE Trinidad Petroleum Company, Limited, will supply samples of their Trinidad PITCH for gas purposes of 1 lb. each free of charge, or samples of 1 ton or upwards at 45s. per ton, delivered on to the railway at Silvertown, on application being made to their SECRETARY, at the Offices of the Company, 110, CANNON STREET, E.C.

UNIVERSAL PARIS EXHIBITION, 1867.

PRIZE MEDAL in Class 24—Heating and Lighting—for Leoni's Patent Gas-Burners and Gas-Stoves.



LEONI'S Patent Adamas GAS-BURNERS are entirely free from liability to Corrosion, Injury from Heat, or danger of Fraction, and are *unalterable* in the dimensions of their Apertures. Uniformity in the consumption of gas is obtained by the process of manufacture, which insures that the burners shall be precisely similar in pattern.

Net Cash Price, 8s. per gross.
Patentee and Sole Manufacturer, S. LEONI, 31, St. Paul Street, New North Road, LONDON, N.

NATURAL
HYDRATED OXIDE of IRON
constantly on Sale. Apply to
MARTYN DENNIS AND CO.,
LIVERPOOL.

WALTER FORD,

159, GRAY'S INN ROAD, LONDON.

MANUFACTURER OF WET AND DRY GAS-METERS, STATION-METERS, GOVERNORS, &c. &c.

Sole Manufacturer of **PADDON'S PATENT STREET-LAMP REGULATORS,** for insuring any required consumption. These Regulators are in general and increasing use, and references can be given to Gas Companies who use them for every Lamp.

GAS EXPLOSIONS PREVENTED

BY THE USE OF

JOHN RUSSELL & CO.'S TUBES & FITTINGS.

Gas Explosions are of frequent occurrence, but we do not hear of them unless death has resulted. As in the case at Clerkenwell lately, gas explosions may generally be traced to the use of Tubes of defective workmanship and inferior iron. Adopt the Tubes and Fittings of John Russell and Co., which are all of the best quality.

JOHN RUSSELL & CO.

ARE THE

INVENTORS OF THE LAP-WELDED TUBE FOR LOCOMOTIVE & MARINE BOILERS,

AND THE OLDEST MANUFACTURERS OF TUBES FOR GAS, STEAM, & WATER.

WAREHOUSES:

69, Upper Thames Street, E.C.; Commercial Street, N.E.; & Charles Street, Soho Square, London; Also at 35, 36, 37, and 39, Granby Row, Manchester.

MANUFACTORIES:

The Old Tube Works, Wednesbury, and the Alma Works, Walsall, Staffordshire.

Address to 69, UPPER THAMES STREET, LONDON, E.C.

CALLEY'S

TORBAY IRON OXIDE PAINTS

Are Durable, Economical, and keep their Colour.

See "The Record of Engineering," 1864.
"The Journal of the Society of Arts," June 1, 1866.
"The Mechanics' Magazine," October 26, 1866.
"The Engineer," November 2, 1866.
"The Building News," November 9, 1866, &c.

WORKS: IRON ROAD, BRIXHAM, TORBAY.
LONDON OFFICE:
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TO GAS COMPANIES, GAS ENGINEERS, GAS-FITTERS, &c.

THE NEWEST DESIGNS FOR

LAMP-POSTS, DWARF GAS PILLARS,

BRACKETS, LAMPS,

GARDEN & DRINKING FOUNTAINS,

GATES, RAILINGS, VERANDAHS,

Balcony Panels, Stable Fittings, Columns, &c., &c.,

Will, upon receipt of particulars, be forwarded by

TURNER & ALLEN,

Ironfounders, Engineers, &c.,

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Contractors for the supply of Lamp Columns, Lamps, &c., to Railway and Gas Companies, Local Boards, &c.

PIPES, TUBES, & FITTINGS FOR GAS, STEAM, & WATER.

NEWTON AND BRADDOCK,

GLOBE METER-WORKS, OLDHAM,

Manufacturers of

STATION METERS, CONSUMERS METERS, GOVERNORS, GAUGES,

PRESSURE AND EXHAUSTER REGISTERS,

EXHAUSTER REGULATORS, &c.

N.B.—The flanges of the plates for the Square Station-Meters are planed so as to ensure perfect joints—guaranteed not to leak.

HONOURABLE MENTION, PARIS EXHIBITION, 1867.

JOSEPH BOULTON,

80, KING'S CROSS ROAD, AND

104, GREAT PERCY STREET, CLERKENWELL.

Manufacturer of the Patent Dry and Improved Unvarying Water-Line Gas-Meters and Station-Meters, Governors, Experimental Meters, and Pressure Gauges, on the most improved principle.

Old Meters thoroughly repaired, and altered to meet the requirements of the Act of Parliament.

ALL METERS WARRANTED.

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GAS ENGINEERS,

Gas-Meter, Gas Apparatus, and Gasfittings Manufacturers,

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NEWGATE STREET, LONDON.

Station-Meters, Governors, Consumers Meters, Gas Lustres, Chandeliers, Brackets, &c., and every description of Gasfittings and Gas Apparatus.

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LEE MOOR PORCELAIN FIRE-BRICKS,

Containing no Lime, and only ·45 of Oxides, resist the strongest heats, and will last for Gas-Works longer than any others.

Samples and prices sent, and the highest references given, on application to

MARTIN BROTHERS,

ST. AUSTELL, CORNWALL.

SAMUEL CUTLER & SON,

CONTRACTING GAS ENGINEERS, &c.

MANUFACTURERS OF GASHOLDERS, TANKS, PURIFIERS,

AND ALL DESCRIPTIONS OF GAS-MAKING APPARATUS.

Iron Roofs, and General Iron Work. Mains Supplied and Laid.

S. C. & SON supply every requirement for a Gas-Work, and keep in stock Retort Lids, Costers, Barrows, Scoops, Bolts and Nuts, &c. &c.

PROVIDENCE IRON-WORKS, MILLWALL, LONDON, E.

EIGHTEEN YEARS PRACTICAL EXPERIENCE.

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RETORT SETTER,

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YORKSHIRE.

Fire-Clay and Iron Retorts, Double and Single Grooved Brick Retorts, of every description.

Bentley's Improved D Brick Segment Retorts, 5 or 3 in one bed.

Testimonials and references on application.

By Her Majesty's Royal Letters Patent.

JAMES HISLOP'S

IMPROVEMENTS IN APPARATUS

FOR

SCURFING RETORTS.

All Engineers and Managers of Gas-Works will admit the importance of securing ready means for the removal of Carbon without endangering the Retort. The Patentee, therefore, feels great confidence in introducing a system by which the Carbon is consumed with rapidity, and without resorting to the destructive use of chisels, which has hitherto been relied on to effect its removal. To those who now experience difficulty in Scurfing their Retorts, the adoption of the improved method would be a great relief, while it would materially add to the durability of the Retorts.

The Patentee will be glad to receive applications for the use of his improvements, and will be happy to supply further information on communicating with JAMES HISLOP, Gas-Works, AYR, N.B.

BEST & HOLDEN'S

PATENT APPARATUS

FOR

CHARGING & DRAWING GAS-RETORTS,

AND FOR

CLOSING THE MOUTHS OF RETORTS

WITHOUT CEMENT.

The above is one of the most important inventions in connexion with gas manufacture which has been introduced for many years, and merits the immediate attention of all Gas Companies. The Machine is simple in its construction, easily worked, and not likely to get out of order, while the saving in time and labour is very considerable. It has been applied at the Chartered Gas-Works, Westminster, with complete success, and has been viewed in operation by some of the most eminent gas engineers, both in London and from the provinces, their unanimous opinion being that the arrangement of the apparatus was perfectly new, and must eventually be adopted by all Gas Companies.

The Patentees are now in a position to treat for the use of their Apparatus.

For further information apply to

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44, MARK LANE, E.C.

THE PATENT RIBBED RETORTS.

A. C. FRASER, Gas Engineer,

Inventor and Patentee of the RIBBED CAST-IRON RETORTS, and RIBBED and GROOVED CLAY RETORTS, which are in use at the Gas-Works, Derby, Shrewsbury, Portsmouth, Nottingham, Colchester, Seaham, Reigate, Whittlesea, Baldock, Syston, Rugby, Barrow-in-Furness, Ripley, Royston, Leighton Buzzard, Risboro', Woking, Loughboro', Kegworth, Donnington, Honiton, Crewkerne, Canterbury, Wincanton, Swadlincote, &c.; Llandudo and Corwen, N.W.; Stornoway, N.B.; Carlow, Longford, Queenstown, and Castlederg in Ireland. They are also extensively used by Proprietors and Lessees of Gas-Works, at several Government Gas-Works, and abroad at Cape of Good Hope, Montreal, Gibraltar, Holland, and Mexico.

For prices, &c., apply to A. C. FRASER, Gas Engineer, COLCHESTER.

THOMAS EDINGTON & SONS,

PHŒNIX IRON-WORKS,

GLASGOW,

Manufacturers of all kinds of

GAS AND WATER PIPES,

Branches, Bends, Water-Traps, Tank-Plates, Valves, and general Castings. Also

RAILWAY CHAIRS & SLEEPERS,

AND

GRIFFIN'S PATENT PERMANENT WAY.

London Office, 63, Old Broad Street.

EDMUND SMITH,

GRASBROOK, HAMBURG,

would respectfully call the attention of engineers and managers of gas-works to his Newly Improved GAS-METER, patented 1862 in England, and the principal parts of the Continent.

Price-lists and tenders for gas-meters, experimental station-meters, experimental holders, governors, purifiers, gasholders, pressure-gauges, gas and water fittings, &c., are forwarded on application.

LAMBERT BROTHERS, WALSALL.

ALPHA TUBE & FITTING WORKS

THE BRITISH IRON TUBE COMPANY,

MANUFACTURERS OF

PATENT WELDED WROUGHT-IRON TUBES & FITTINGS, FOR GAS, STEAM, & WATER;

SCREWING TACKLE, CORE BARS,

HYDRAULIC & OTHER TUBES & COILS, TO ORDER.

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LLOYD AND LLOYD,

ALBION TUBE-WORKS, BIRMINGHAM,

MANUFACTURERS OF

WROUGHT-IRON TUBES & FITTINGS,

PLAIN, GALVANIZED, & ENAMELLED, for Gas, Steam, and Water, from $\frac{1}{8}$ in. to 6 in. bore.

STOCKS, TAPS, and DIES, GUN METAL GLAND-COCKS, WATER-GAUGES, &c.

PATENT LAP-WELDED IRON TUBES

For Locomotive and Marine Boilers, &c.

LONDON WAREHOUSE—Nº 66, QUEEN STREET, E.C.

1862.

PATENT ANTIMONY PAINT.

MADE ONLY BY

GEORGE HALLETT & CO.,

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CLASS II.

This Paint having been in general use over four years (especially in some of the principal Gas-Works), and proved itself the best light-coloured Paint produced for resisting the influence of vitiated atmospheres, it is important that its qualities should be more widely known.

It is not discoloured like white lead in a sulphuretted atmosphere, nor washed off like white zinc; and its light colour reflecting heat, produces much less expansion of gas in holders painted with it than with dark colours, besides rendering them much more sightly. Its specific gravity is so much below white lead that the same weight will cover one-third more surface, while it is equal in body; and its price being about the same (28s. per cwt.), it is actually one-third cheaper. From experience, its manufacture is greatly improved, and it is quite suitable for all purposes in which white lead is employed.

Reference is kindly permitted by the Engineers of the City of London, Commercial, London, and Surrey Consumers Gas Companies, who pronounce it the best Paint known for their purposes.

N.B.—Antimony Paint, COVERING SO MUCH MORE WORK, costs under 20s. per cwt., as compared with White Lead at 28s. per cwt.

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Prices, according to size, can be obtained upon application to

Mr. WILLIAM ARCHER,

METER COMPANY'S WORKS, OLDHAM.

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INVENTOR OF THE FIRST SUCCESSFUL

DRY GAS-METER.

210,000 IN USE.

WORKS:

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KIRKWOOD CANNEL COAL.

This Coal is largely used in the Gas-Works at Glasgow, Paisley, Port Glasgow, Edinburgh, Leith, and many other towns throughout Scotland. It yields 10,648 cubic feet per ton; illuminating power, 27·55 standard candles; coke per ton, 9 cwt. 83 lbs. Railway communication from the pits (at Coatbridge) to all parts of the country; ports of shipment in Firths of Forth or Clyde.

For quotations, &c., apply to Mr. JOHN MACDONALD, 68, St. Vincent Street, GLASGOW.

FIRE-CLAY GAS-RETORTS, &c., CANNEL AND STEAM COALS.

WILLIAM FRASER, Inverkeithing

(owner of the Works at which Fire-clay Retorts were first made), having greatly enlarged his works, can supply retorts and other fire-clay goods to any extent.

References can be given to managers of above a hundred Gas-Works whom he supplies.

WILLIAM FRASER ships COWDENBEATH PARROT COALS at Charlestown and Burntisland at 11s. per ton; and HALBEATH STEAM COALS, on Navy List, at 8s. 6d. per ton.

JAMES OAKES and CO.,

ALFRETON IRON WORKS, DERBYSHIRE,

AND

WENLOCK IRON WHARF, 20, WHARF ROAD, CITY ROAD, LONDON,

Beg to inform Gas and Water Companies and the public, that they keep in stock in London all the CASTINGS in general use in Gas and Water-Works, including Iron Retorts, Socket and Flange Pipes, Bends, Branches, and Syphons of all sizes, Lamp Columns, &c., &c.

N.B.—Orders for Cast-iron Tanks, Girders, Columns, Cylinders, and all irregular castings, will have immediate attention.

CHARLES HORSLEY, Agent.

OXIDE OF IRON,

We are prepared to supply, on moderate terms,

HYDRATED PEROXIDE OF IRON (BOG OCHRE),

Same quality as supplied by us to several of the most extensive Gas Companies, and which has given entire satisfaction.

FRANCIS RITCHIE & SONS,

BELFAST.

INTERNATIONAL EXHIBITION,

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PRIZE MEDAL

For excellence of Fire-Clay Gas Retorts, and "HONOURABLE MENTION" for good quality of Fire-Bricks.

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NEWCASTLE-ON-TYNE.

THOMAS CARR & SON,

MANUFACTURERS OF

FIRE-BRICKS, LUMPS, TILES, RETORTS, &c. &c.

SCOTSWOOD FIRE-BRICK WORKS,

NEAR

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HARRIS and PEARSON,

PROPRIETORS OF

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AMBLECOTE FIRE CLAY AND BRICK WORKS, STOURBRIDGE.

Late in the occupation of I. and W. King. Originally J. Pidcock, Esq.

NB A quantity of best Clay Retorts in stock, viz.—Circulars, 14 inches, 15 inches. 16 inches. D's, 16×12, 15×14, 20×16, 16×18.

HANCOCK'S INDIA-RUBBER GAS-TUBING.

All sizes, from ¼ in. to 4 in. diameter and upwards.

Also,

HORSE SINGEING APPARATUS, best make, with GAS-BURNERS, COMBS, and INDIA-RUBBER TUBING, all complete.

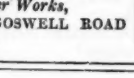
INDIA-RUBBER BAGS for GAS-MAINS.

WASHERS for GAS and STEAM JOINTS.

VALVES (pure solid Rubber) for STEAM-ENGINES.

PACKING (Elastic) for STEAM-ENGINES.

FLANGE TUBING, for excluding Draughts and Dust through WINDOWS, DOORS, and GLASS CASES.



Section.

Illustrated Price Lists on application.

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Vulcanized India-Rubber Works,

GOSWELL MEWS, AND 286, GOSWELL ROAD LONDON, E.C.

Trade Mark. **THE MEDAL FOR 1862.**

THE ONLY PRIZE MEDAL AWARDED FOR TUBES AND FITTINGS.

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OFFICE: 14, Park Street, WESTMINSTER.

ALFRED PENNY, Gas and

CONSULTING ENGINEER,

WENLOCK IRON WORKS,

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Mr. PENNY having had a large experience in the construction, alteration, and management of Gas-Works, begs to inform the Directors of Gas Companies that he may be consulted on all matters appertaining thereto. He also manufactures Gasholders, Purifiers, and all the various apparatus used in Gas-Works, and keeps in stock Retorts and Mouthpieces, Socket-Pipes, Bends, Branches, T-pieces, &c. &c.

Plans, Specifications, and Estimates prepared.

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SOCKET, FLANGE, HOT-WATER PIPES, AND ALL CONNEXIONS; RETORTS, HYDRAULIC MAIN, LAMP-COLUMNS, &c.; AND EVERY DESCRIPTION OF CASTINGS AND WROUGHT-IRON-WORK FOR GAS AND WATER-WORKS, STEAM, AND GENERAL PURPOSES.

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Manufactory for every description of Casting and Machinery for Gas-Works and Water-Works.

Warehouse in London for Cast-iron Pipes and Connexions of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.

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BELGIAN CLAY RETORTS.

J. SUGG and CO., late ALBERT KELLER, Ghent.—The removal of the import duties on Earthenware permitting the entry of Clay Retorts into England, Messrs. Sugg, of Ghent, beg to draw the attention of the Gas Companies of London, and other Cities, to the very superior quality of the RETORTS manufactured by them. They can be made of any size, in one piece, and of any form. The price will be in proportion to the weight, and very moderate in comparison to their value.

Communications, addressed to J. SUGG and CO., GHENT, will receive immediate attention.

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Gas-Meter Manufacturer,

FOUNTAINBRIDGE

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NEAR NEWCASTLE-UPON-TYNE,

Manufacturer of Clay Retorts, Fire-Bricks, and every description of Fire-Clay Goods.

BEST AND HOBSON,

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ROBERT BEST,

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Manufacturers of

CHANDELIERS, PENDANTS, BRACKETS,

Brass and Iron Gas-Fittings, Steam and Water-Cock &c., &c.

Also,

PATENT WELDED IRON TUBES,

For Gas, Steam, Water, and other purposes.

GAS APPARATUS OF EVERY DESCRIPTION.

High-pressure Water-Valves and Cocks, &c., &c.

Plumbers Brassfoundry,

BRASS, COPPER, COMPOSITION, AND LEAD TUBES.

Works: Birmingham, and Great Bridge, Staffordshire.

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GAS-METER MANUFACTURERS.

STATION-METERS ANY SIZE.

PHOTOMETERS, EXPERIMENTAL METERS

PRESSURE-GAUGES, &c.

Price List on application.

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STOURBRIDGE FIRE-CLAY WORKS.

E. BAKER & CO.,

24 WHARF, HARROW ROAD, PADDINGTON, W.

FIRE-BRICKS, LUMPS, SQUARES, and TILES of all dimensions.

GAS-RETORTS always in stock.

GARDEN EDGINGS of various patterns.

ORNAMENTAL BUILDING BRICKS.

GRATE BACKS in various designs.

Contracts entered into to set Retorts, erect Furnaces, &c.

Shipments on the shortest notice.

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(Established 1820,)

FIRE-BRICK AND TILE MERCHANTS,

Wholesale and for Exportation,

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SOUTHWARK, LONDON, S.E.,

DEPÔT for STOURBRIDGE AND NEWCASTLE FIRE-BRICKS, LUMPS, TILES, and FIRE-CLAY, and every Article suitable for

GAS AND WATER WORKS.

B. CARPENTER'S Improved Wood SIEVES for Gas-Purifiers.

Works: 14, John Street, Pentonville Road, LONDON, N.

The above sieves are used by the principal gas companies in London and the country. Their utility, durability, and cheapness combined, render them superior to all others.

Testimonials from gas engineers who have tested their qualities forwarded on application.

All orders punctually attended to, and estimates given if required.

J. T. B. PORTER & CO.,

GAS ENGINEERS,

MANUFACTURERS AND CONTRACTORS FOR GAS-WORKS

Of any extent at Home and Abroad,

GOWTS BRIDGE WORKS, LINCOLN,

AND

JOHN STREET, ADELPHI, LONDON, W.C.

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Manufacturers of all sizes of Cast-Iron Main Pipes, by an improved Patent. General Ironfounders, Gas Engineers, and Wrought-Iron Tube Makers.

JAMES M'KELVIE,

CANNEL COAL MERCHANT,

HAYMARKET,

EDINBURGH.

Established 1840.

WALTER MABON & CO.,

Engineers,

ARDWICK IRON-WORKS,

FAIRFIELD STREET, MANCHESTER,

MANUFACTURERS OF

IRON TANKS, GASHOLDERS,

GAS APPARATUS,

PIPES, VALVES, IRON ROOFS,

WROUGHT AND CAST-IRON GIRDERS.

DESIGNS, SPECIFICATIONS, & ESTIMATES FURNISHED.

TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT, having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their invention may be secured for Six Months; or LETTERS PATENT, which are granted for Fourteen Years.

Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.

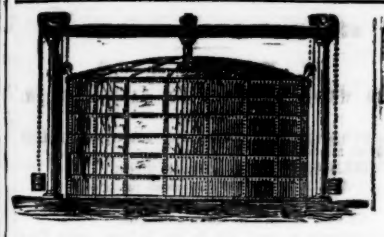
Patents procured for Foreign Countries.

Information as to cost, &c., supplied gratuitously upon application to the advertiser, 49, Parliament Street, WESTMINSTER. [Office of the JOURNAL OF GAS LIGHTING, &c.]

GAS AND WATER PIPES.

CLARIDGE, NORTH, & CO.,

BILSTON.



IMPROVED GAS APPARATUS,

FOR TOWNS, VILLAGES, &c.,

INVENTED AND MANUFACTURED BY

W. C. HOLMES & CO.,

WHITESTONE IRON-WORKS, HUDDERSFIELD.

WILL BE SENT ON APPLICATION:—

PLANS, SPECIFICATIONS, and PRICES of GAS APPARATUS;

PLANS, SPECIFICATIONS, and ESTIMATES of the requisite BUILDINGS for each size of Apparatus;

PLANS of the IMPROVED ANNULAR CONDENSERS;

PLANS of the COMBINED PURIFYING APPARATUS, so eminently adapted for Exportation.

LONDON OFFICES—56, GRACECHURCH STREET, CITY.

*** *Please address letters to the London Offices.*

EXPOSITION UNIVERSELLE, PARIS, 1867.

The JURIES of CLASSES 24 and 53 have AWARDED a

PRIZE MEDAL

TO

WILLIAM SUGG,

For KIRKHAM & SUGG'S SELF-REGISTERING PHOTOMETER,

LAMP GOVERNORS, &c.

The Catalogue and Lists of Prices for all the New Instruments and Apparatus of his Manufacture are now ready, and may be had on application, per post or otherwise, at

VINCENT WORKS, VINCENT STREET, WESTMINSTER, S.W.

WILLIAM INGHAM AND SONS,

WORTLEY FIRE-BRICK AND RETORT WORKS,

Near

Leeds.

W. INGHAM and SONS, having for many years been extensively engaged in the Manufacture of

RETORTS AND FIRE-BRICKS FROM THE CELEBRATED WORTLEY FIRE-CLAY

beg to call especial attention to their RETORTS, which have for many seasons proved to be unsurpassed in quality by any in the Kingdom, their FREEDOM FROM CRACKS and the ADHESION OF CARBON rendering them worthy the attention of all parties interested in the making of Gas.

The Works are of such magnitude as to ensure the prompt execution of orders to any extent.

Estimates for Setting, or Bricklayers sent when required.

GAS OVENS IN SEGMENTS OF EQUAL QUALITY.

A large stock of Fire-Bricks, Fire-Clay, Terra Cotta, and Drain-Pipes of all sizes kept in London at CHRISTIE & CO. Wharf, 64, Bankside, Southwark, where all particulars of Prices, &c., may be obtained.

N.B.—*Export orders continue to have prompt attention.*

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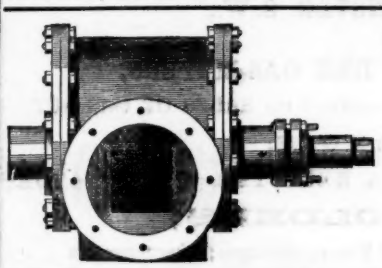

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